

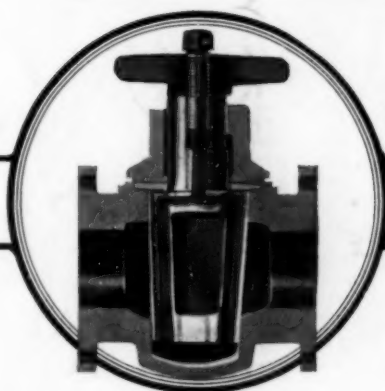
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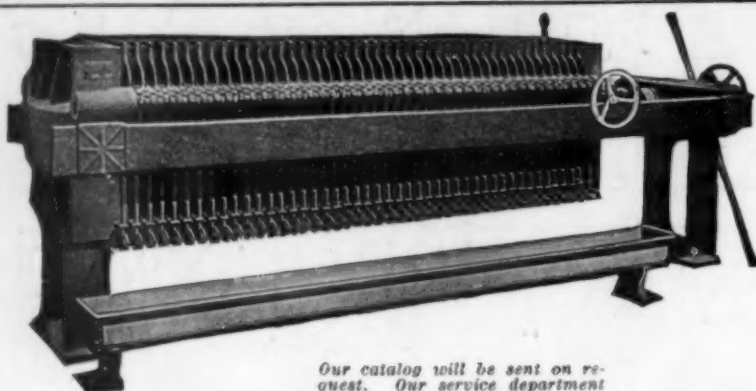
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CHEMICAL & METALLURGICAL ENGINEERING

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Chromium Plating For Corrosion Resistance

PLATING with metallic chromium is a process now in that stage of development where it is known to be practicable but is not yet widely adopted. It is still being developed, but it cannot be long before such an efficacious protection against corrosion becomes a familiar device of the chemical engineer. It behooves the latter, therefore, to learn all that is known about it so that he may be ready to utilize it to best advantage when it has received those final touches necessary to make it industrially applicable.

There appears in this issue an article giving the details necessary for the production of a satisfactory chromium plate and describing its resistance to the action of various corroding agents. The explanation of this resistance is not difficult to find. It is well known that many of our best corrosion-resisting metals contain large percentages of chromium. This is not a coincidence; their efficacy is due to a surface film made up largely of chromium oxide, which has a most remarkable combination of properties. This film is thin, invisible, continuous and non-porous. It adheres tightly to the metal and it has almost the same coefficient of expansion as the metal itself. In addition to being unaffected by most oxidizing agents, this oxide has the advantage that it is not reduced by such molten metals as tin and zinc. It is not surprising therefore that chromium plating, which acquires a surface film made up almost entirely of chromium oxide, should provide excellent protection against corrosion.

Technical Literature As First Aid to Research

IN conversation with a technologist recently we were bombarded with questions as to the probable effect of the addition of certain metals in the manufacture of alloy steel. Our knowledge of the subject not being encyclopedic, we were soon nonplussed; but we succeeded in parrying the attack by means of a query as to the reason for the inquisitiveness. From the answer it appeared that our friend was spending a considerable amount of time and money on experimentation, mostly in connection with reactions which, in whole or in part, were well known. It was suggested that he make a study of published research in this particular field, in addition to keeping in touch with contemporary literature on the technology of the subject. To which he replied that he hadn't the time!

One of the commonest of industrial mistakes is seen in duplicated research, against which technical and scientific journalism offers the best insurance. No excuse can be offered in these enlightened times to explain ignorance on any subject of technical moment on which research is planned. If time is available for experimentation, it is available for research into the published records of the subject; it is available for following the trend and results of current progress.

Liberty and the Pursuit of Health

LIBERTY in the United States is an accepted privilege that one is inclined to assume is enjoyed to the same extent by no other nation on earth. Yet when the authorities at Rochester, N. Y., decided to adopt the compulsory dosage of the inhabitants with iodine, by the periodic addition of sodium iodide to the municipal water supply, no protest was raised. It was realized that the prevention of goiter was desirable for the good of the individual as well as for the good of the community; and, as the amount added was such that its presence was undetectable by taste or smell, it was obvious that no hardship was inflicted. Those who scorn the idea of material ills and who disbelieve in the presence or effect of organisms, bacteria or bacilli of any kind, or the effect of the lack of the essential elements in the human metabolism, might well have raised protest. But one heard nothing to indicate that any appreciable opposition was felt against an act that elsewhere would have been construed as an interference with personal liberty.

Note the attitude across the Atlantic, however, where one hears little about the privileges of liberty, but where trenchant protest is immediately forthcoming against any official action that seems to usurp the personal freedom of the citizen. An English contemporary in our own field quotes what is considered "a most curious instance of bureaucratic interference with the rights of the populace." "It is well known," the editor adds, "that potassium iodide is an excellent remedy for the disease goiter, so common in the mountainous districts of Europe. Some kindly bureaucrat, having heard of this, concluded that the metabolism of the inhabitants of Austria was in decided need of improvement. The means was at hand; the decree went forth. Salt production in Austria is a government monopoly; so, in future, culinary salt in that country will contain 0.005 gram of potassium iodide to each 1,000 grams of sodium chloride."

After all, every official attempt to prevent disease might be construed as a bureaucratic interference with the rights of the populace. Worldwide efforts are being made to insure the purity of municipal water supplies by the removal of what is harmful. It is merely one step further to add something to the water that common sense and science may dictate for the general improvement of the health of the community. The use of copper sulphate for the destruction of algæ in water has proved eminently successful in practice and is used in large amount; but no sane person could complain that the water-supply officials are exceeding their rights in removing what may prove a menace to health.

Liberty is something worth possessing; but those in authority should have the liberty to take whatever steps common sense and science may dictate for the general improvement of the health of the community. The condemnation of unsanitary wells and the provision of pure water is no more a bureaucratic interference with the

private rights of the citizen than is the addition of a minute amount of iodine to the supply in an endeavor to prevent a disease that arises because of a lack of that element. Only when our bureaucrats are willing and have the liberty to pay heed to the teachings of science can we expect an improvement in health and conditions of living commensurate with the advance in knowledge.

Maximum Gas Service Per Dollar of Cost

CITY gas is used by the industries as a fuel because of the heat which it makes available. Efficiency in gas service is, therefore, measured by the amount of useful heat delivered to the user per dollar of cost. The heating value of the gas in B.t.u. per cubic foot is just as important to most purchasers as the price per cubic foot, for both have a direct bearing on the monthly gas bill for a given job.

Several readers have taken issue with our earlier editorial comment in which we sought to emphasize these principles, and letters from two of them are published in this issue. One argues that the quality of the gas is dependent upon the characteristics of combustion such as flame temperature, rate of flame propagation and the concentration of heat units in the products of combustion. These factors are at times significant, but they are not of great value in judging the general usefulness of a gas supply for city or industrial distribution. Only the B.t.u. per cubic foot can fairly serve as a measure of general usefulness.

But this fact does not justify an insistence upon a gas of high heating value. The reader above mentioned apparently misunderstood us on this point. *Chem. & Met.* does not favor "high" standards or requirements of heating value. Rather we urge the selection of such basis of quality as will permit delivery of the most heat per dollar of cost. No other basis can be really justified, whether the result be 450 B.t.u. or 600 B.t.u. gas.

For practical purposes all of the heat in a gas can be regarded as equally useful. On such basis a gas of 400 B.t.u. per cubic foot would be substantially four-fifths as valuable to the user as one of 500 B.t.u. per cubic foot; and in actual practice this will generally be true. Even comparing such extreme kinds of gas as producer gas, coke-oven gas and natural gas, which certainly differ from one another as radically as any that are met industrially, there is little difference in efficiency in the use of the heat they contain except for extreme conditions. For example, there should be less than 3 per cent variation from the average efficiency for these three gases in so extreme a condition of use as for furnace heating where the products of combustion go to the flue at 2,000 deg. F. and the surplus air used is 100 per cent above the minimum theoretically necessary for combustion. With customary methods of use and lower temperature of flue products, these three gases would be used with the same thermal efficiency within perhaps 1 per cent. In view of these facts, industry should certainly be encouraged to buy gas on the basis of its heating value per dollar of cost, just as it is urged to buy coal on a heat-unit basis.

In any case where a proposed modification of standards for gas quality neglects these fundamentals it is certainly time to call a halt for reconsideration of the case. The value of city gas service can be measured only by the total heat contained, or the product of the volume and the B.t.u. per cubic foot of the gas delivered.

The few cases where marked variation from this relationship exists are in the small minority among city gas users; and they, therefore, cannot be considered as of importance when selecting a basis of operation for gas supply to the community as a whole.

Research and the Nitrate Producers' Association

PROSPECTS of extending the life of the Nitrate Producers' Association of Chile appear assured. In so far as the support of sellers and buyers is concerned, it is evidently in a strong and influential position. A recent market incident was of significant indication: On Feb. 14 the association offered 100,000 tons of 95 per cent nitrate for sale, in Chile, for delivery in the latter half of June, at 19s. 3d. per quintal, which is 3d. per quintal above the price ruling for the same time last year. By Feb. 21 bids had been received for 329,000 tons, in consequence of which the association allotted 200,000 tons, or about 60 per cent of the amount sought by each buyer. This indicates the close control of the marketing end of the industry.

Combinations are hurtful if they restrain trade and diminish general prosperity. The Chilean nitrate industry passed through more than one crisis, with widespread distress and disorganization, before it was realized that the control of selling price and the maintenance of a measure of stability were essential to commercial success. Similar co-operative efforts are sanctioned and in successful application in many industries in the United States. The Chilean association, moreover, has the active support of the Chilean Government. In fact, government officials appointed by the President of Chile act as directors in collaboration with others who represent the various nationalities interested in the industry, except Americans, who are prevented from active participation because of the provisions of the Sherman act.

Apart from the control of prices and the stimulation of demand, the association is nominally pledged to encourage any new method that promises a reduction in the cost of manufacture or an increase in yield per ton. In other words, one of its functions is the stimulation of research and the encouragement of inventions of a practicable nature. Unfortunately until the last year or so the solution of the problems involved in the treatment of caliche was one that attracted the attention of such a host of inventors, most of whom foreshadowed revolutionary results from the adoption of complicated apparatus and impracticable schemes, that the association was unable to give adequate attention to the task of segregating the good from the bad. Neither could it take steps to encourage the introduction of any process the adoption of which might prove of significant moment to the prosperity of the industry as a whole.

The function of such an association should be something more than the fixing of prices; and most of the success of organizations of a somewhat similar nature in the United States has been due primarily to the encouragement of initiative and the introduction of improved technical methods, the results of intensive research and the development of what is meritorious in method and invention. Conditions on the Chilean nitrate pampa have changed considerably in recent years; countless schemes for the treatment of caliche have been tried and discarded, and the process of eliminating the impracticable and the worthless has resulted in

the narrowing of the field for profitable research within reasonable limits. When the association takes on a new lease of life, it is to be hoped that it will modify its statutes so that the encouragement of a scientific appreciation of the technical problems involved will be placed in the forefront of its program.

Monopolies are of uncertain duration in these days of revolutionary achievement, and the Chilean nitrate industry would do well to heed this fact. The prevention of topheavy booms, as well as the occurrence of industrial slumps, is desirable; but no industry of such a character can remain a dominant factor in world economics unless it keeps abreast of modern advance in the field of applied science.

A Symposium on Ammonium Nitrate

DURING the 2 years and 7 months that have elapsed since the fatal Oppau explosion, the culprit—ammonium nitrate—has been under closest scrutiny in Germany, England and this country. By an official order of the German Reichstag dated Sept. 28, 1921, a select commission of experts began an intensive investigation that has been concluded only within the last few weeks. The investigating body included among others such distinguished authorities as Professor Wöhler of the Technische Hochschule at Darmstadt, Professor Kast of the Chemisch-Technischen Reichsanstalt of Berlin, Dr. Gutbier of Stuttgart and Dr. Escales of Munich. The commission's voluminous report, an abstract of which appears in the March 13 and 20, 1924, issues of the *Chemiker-Zeitung*, has been supplemented by many contemporary studies of ammonium nitrate. Thoroughly scientific attempt has been made to ascertain its various properties and to arrive at some quantitative measure of its behavior under varying conditions. It is a report of fundamental work of this character by Dr. Rudolf Aufschläger that Hugo Schlatter has translated for publication in this issue of *Chem. & Met.*

In the United States an equally distinguished army has been marshaled for the attack on ammonium nitrate. A committee of the National Research Council headed by Dr. Charles E. Munroe, the dean of American explosives experts, and including in its personnel well-qualified representatives of the makers and users of explosives, has spent almost 2 years in its study. The results of the committee's investigations, which Dr. Munroe has consented to summarize briefly for us, forms the second feature in our present treatment of this important subject.

The third contribution is from the manufacturers of explosives. Naturally they are vitally concerned with ammonium nitrate in every stage of its manufacture, transportation and storage. Their own experience has taught them a certain wholesome respect for it and has given them a particularly sympathetic attitude toward the scientist's quest for more fundamental knowledge of its properties and behavior. The manufacturer's comments on Aufschläger's conclusions are just as sincere, therefore, as are his interesting theories on the probable cause of the recent and disastrous Nixon explosion. And in the latter connection it is at least significant that two of the manufacturers hold the view that in the last analysis the presence in the ammonium nitrate of organic impurities such as carbonaceous material must be held responsible for its tragic misbehavior.

In bringing together this symposium of views on ammonium nitrate, it is *Chem. & Met.*'s desire to focus attention on the fundamental data that are gradually being accumulated. There is no cause for alarm in the fact that we do not know all there is to be known about this material. Rather it must be our incentive for filling in the few remaining gaps—for carrying on and extending the investigations now under way to the end that eventually scientific knowledge will make impossible the recurrence of disastrous explosions of ammonium nitrate.

Value of Proper Insulation In the Petroleum Industry

LIKE the cobbler's son, whose shoes were always most in need of repair, the petroleum industry has until recently set a vicious example of inefficiency among the industrial users of fuel. This wasteful practice was no doubt a heritage from the days when the cruder distillates were valueless byproducts that the petroleum refiner would gladly have given away. Lately, however, the broadening industrial and domestic market for fuel oil and the new and profitable outlets for heavier products have brought the oil industry face to face with its own fuel problems. More and more attention has been given not only to improving the methods and equipment for burning the different fuels but also to conserving, by means of proper insulation, the heat once it is generated.

In his admirable book on American petroleum refining, H. S. Bell has reflected both the determination with which the refiner has attacked the problem of heat conservation and the means and equipment he has developed for the purpose. More recently the same author, in a series of articles now appearing in *National Petroleum News*, has brought the subject to the attention of the industry in a very practical way. In translating the industry's heat losses into terms of the coal pile, he has arrived at some figures that are indeed startling. He takes for his example an ordinary uninsulated still of 500-bbl. capacity that is subjected to an average temperature of 450 deg. F. for 80 per cent of the working year. For an average air temperature of 60 deg. F. he calculates the heat loss at 8,300,000,000 B.t.u. per year for the still alone. In the still setting, assuming an average temperature of 1,000 deg., there is an additional loss approximately 2,380,000,000 B.t.u. per annum, which brings the impressive total to 10,680,000,000 B.t.u. Translating this into terms of coal of 14,000 B.t.u., we find that the loss is equivalent to 382 tons if burned at 100 per cent efficiency. However, since the efficiency of the direct-fired still of this type rarely exceeds 25 per cent, the actual loss would probably be nearer four times this figure, or 1,528 tons.

Mr. Bell's example specifies conditions that fortunately at the present time exist in only a very few refineries. Insulation is almost universal, yet some of the materials used and their methods of application are so faulty as to be little better than the bare steel surfaces and the common brick walls. Enormous heat losses are still common, even though modern methods of construction and the use of efficient insulating materials have been demonstrated to save as much as 95 per cent of the total heat loss.

There are few, if any, other problems in petroleum refining in which a small investment will yield so profitable a return as in the use of insulation for promoting efficient heat utilization.

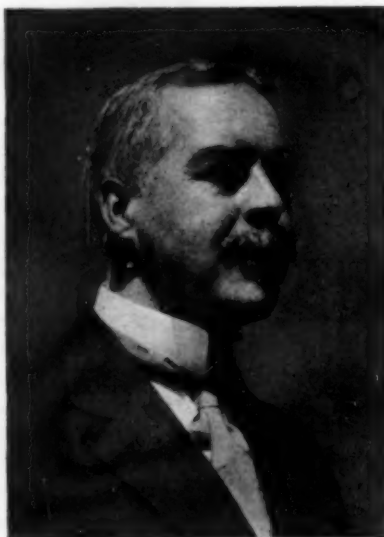
Industry's Firm Foundation

The Award of the Willard Gibbs Medal to Gilbert Newton Lewis Is a Reminder That Research in Pure Science Is Vital to Human Progress

BACK in 1878 a professor of mathematics at Yale read a remarkable paper to a group of his colleagues. Doubtless some of them followed his reasoning and appreciated the versatility of the man. But none understood the paper. For more than twenty years it remained obscure and then by chance it was resurrected by a Dutch chemist, Roozeboom. The phase rule is the result of the resurrection and interpretation of the work—a fundamental scientific principle that has revolutionized and created industries. The professor was Willard Gibbs.

This story is well known, and yet it can never be repeated too often. It is the final and complete answer to the superficial critic that demands utility from research. By any possible criterion the utility of Willard Gibbs' work was nil for twenty years. It was work that could have had no reason for existence had we applied the calipers of pragmatism. But there is no one to protest its value today. The stone that the builders rejected has become the head of the corner.

It is appropriate that a coveted prize of chemistry should bear the name of Willard Gibbs and it is equally appropriate that Gilbert Newton Lewis should have been selected as the recipient of the honor. Like Gibbs, Lewis is a pioneer. His fundamental work in the field of thermodynamics is epoch-making from the standpoint not only of scientific advance but of presentation. An excerpt from the preface of his book on



Gilbert N. Lewis

Professor of Chemistry in the University of California and Willard Gibbs Medalist for 1924

this subject is indicative of this spirit.

"Science has its cathedrals, built by the efforts of a few architects and of many workers. In these loftier monuments of scientific thought a tradition has arisen whereby the friendly usages of colloquial speech give way to a certain severity and formality. While this may sometimes promote precise thinking, it more often results in the intimidation of the neophyte. . . ."

In still another field is Lewis a pioneer, a creator. His constructive work on atomic structure has acted as an admirable balance wheel in the development of a tenable theory. The great physicists were already flying off at a tangent in advocating a type of atom that was not compatible with chemical phenomena. Lewis' "static atom"—a concept originally designed to account for

chemical valence in terms of electrons—has aided materially in the intelligent understanding of atomic structure.

Born in Weymouth, Mass., he took his Bachelor's degree at Harvard and continued his post-graduate work there. His doctor's thesis predicted achievement, for even in it the possibility of a third law of thermodynamics was indicated. After several years at German universities he returned as instructor to Harvard and later was appointed to the faculty of the Massachusetts Institute of Technology. After 11 years at Tech he was invited to become professor of chemistry and dean of the department at the University of California, where he has created a unique school of chemical research.

It is perhaps a legitimate cause of satisfaction that Lewis has been appreciated and honored by his contemporaries sooner and more generally than was Gibbs. It is a satisfaction because it may indicate that we are now more alert to acknowledge scientific advance.

To the industrialist who may be on the lookout for "practical" applications of this fundamental knowledge a word of warning may be said. There is not and there should not be a thought of application in the forging of scientific truth. Application comes after the truth is forged. The wise man therefore will avoid an attitude that has in it anything but appreciation and encouragement, for scientific research is the vitamin of industrial health.

Is Ammonium Nitrate an Explosive?

Ammonium Nitrate and Its Mixtures, Although Extremely Insensitive, Can Be Detonated With Certainty Under Some Conditions

By Dr. Rudolf Aufschläger

Translated by Hugo Schlatter, chemical engineer, Wilmington, Del., from *Zeitschrift für das gesamte Schiess- und Sprengstoffwesen*, vol. 18, p. 117, November-December, 1923

IN ORDER to judge whether a substance is capable of explosive decomposition, it is necessary to establish a theoretical chemical equation representing this decomposition, from which the quantity of the heat liberated, the so-called heat of explosion, may be calculated. This quantity is the difference between the sum of the heats of formation of the decomposition products and the heat of formation of the explosive substance or the sum of the heats of formation of the components of the explosive system. This heat is usually calculated per kilogram of explosive and in most cases two values are obtained; the one on the assumption that the water formed is in the form of steam, the other on the assumption that the water is obtained as a liquid. The former value is the basis for the calculation of the explosion temperature, since the water at the moment of explosion is in gas form; the second value is necessary when the calculated heat of explosion is compared with the value obtained in the calorimeter, since in this case the water becomes liquid.

As regards the establishment of an equation to represent the decomposition of ammonium nitrate, there are quite a number of possibilities. Berthelot (Escales, *Ammonsalpetersprengstoffe*, 1909, pp. 41-45) gives the following seven possibilities:

- (1) $\text{NH}_4\text{NO}_3 = \text{NH}_3 + \text{HNO}_3$
(Dissociation, at low temperatures)
- (2) $\text{NH}_4\text{NO}_3 = \text{N}_2\text{O} + 2\text{H}_2\text{O}$
(Decomposition when slowly heated and at relatively low temperature)
- (3) $2\text{NH}_4\text{NO}_3 = 2\text{N}_2 + 4\text{H}_2\text{O}$
(Explosive decomposition when suddenly heated to high temperatures)
- (4) $2\text{NH}_4\text{NO}_3 = 2\text{NO} + \text{N}_2 + 4\text{H}_2\text{O}$
(Side reaction occurring with 3 when initiation is insufficient)
- (5) $3\text{NH}_4\text{NO}_3 = 2\text{N}_2 + \text{N}_2\text{O} + 6\text{H}_2\text{O}$
- (6) $4\text{NH}_4\text{NO}_3 = 3\text{N}_2 + 2\text{NO} + 8\text{H}_2\text{O}$
- (7) $5\text{NH}_4\text{NO}_3 = 2\text{HNO}_3 + 4\text{N}_2 + 9\text{H}_2\text{O}$

Since equation 3 shows the greatest development of heat and sudden heating to a high temperature occurs when the explosion is initiated with a strong cap, as was done in the following experiments, this possibility is practically the only one to be considered for the explosive decomposition of ammonium nitrate.

For this case the following values for the heat of explosion (at constant volume Q_v) of ammonium nitrate are found in the literature:

Authority	Q_v (H_2O Gaseous)		Q_v (H_2O Liquid)	
	Per Mol.	Per Kg.	Per Mol.	Per Kg.
Berthelot*	33.7 Cal.	421 Cal.	50.9 Cal.	636 Cal.
Heise†	381 Cal.	.....	.....
Brunswig‡	630 Cal.
Kast§	347 Cal.	.....	.....
I calculated	375 Cal.	.....	628 Cal.

*Sur la force des matières explosives, 1883, Vol. I., p. 66.

†Sprengstoffe, 1904, p. 99.

‡Explosivstoffe, 1909, p. 6.

§Spreng- und Zündstoffe, 1921, p. 70.

The disastrous explosion at Nixon, N. J., on March 1, 1924, the most recent of a number involving ammonium nitrate, has served to emphasize again the need for more detailed information in regard to the explosion hazard of ammonium nitrate and its mixtures. This article and the expert opinion that follows it summarize our present knowledge of the explosibility of these compounds.

The experimental determination of the heat of explosion involves considerable difficulties. The writer used a nickel-steel bomb of 40-c.c. capacity and found that the ammonium nitrate (5 grams) could be detonated completely only with a No. 8 copper cap. The different calorimetric results agreed well enough among themselves, but were decidedly higher than the calculated ones, although the heat developed by the complete oxidation of the cap gases was taken into consideration. These large differences can be explained only by the assumption that the oxygen liberated in the explosion oxidizes the wall of the bomb, the insulating material of the igniter and, not least, the fine copper splinters of the cap walls, and thus evolves heat. The amount of this heat cannot be obtained experimentally or by calculation, as it is impossible to determine the quantities of the oxygen entering into combination with the different substances or of the products formed.

The temperature of explosion has been stated by Heise to be 1,134 deg. C. (Sprengstoffe, 1904, p. 99), by Brunswig, to be 2,120 deg. C. (Explosivstoffe, 1909, p. 78), and by Kast to be 1,500 deg. C. (Spreng- und Zündstoffe, 1921, p. 71), whereas the writer obtained a value of 1,121 deg. C.

According to Berthelot (cf. Escales, *Ammonsalpetersprengstoffe*, 1909, p. 39), the decomposition of ammonium nitrate begins, when slowly heated, even below 210 deg., becomes more rapid between 230 and 300 deg., and becomes explosive above that temperature. Lobry de Bruyn (*Rec. trav. chim.*, 1891, vol. 10, pp. 127-131) showed by experiments in grenades with mercury fulminate ignition, or fulminate and bellite (consisting of ammonium nitrate and dinitrobenzol), that ammonium nitrate alone under suitable conditions (sufficiently heavy detonator and strong confinement) is explosive, but exhibits, as shown by drop hammer trials, a high degree of insensibility to shock. Nothing definite is found in the literature about the velocity of detonation; Escales mentions casually that this value

has not been determined (Ammonsalpetersprengstoffe, 1909, p. 49); Kast (Spreng- und Zündstoffe, 1921, p. 71) estimates it at 5,000 meters per second, a value that is certainly much too high.

INSENSIBILITY TO SHOCK

From this often cited insensibility of ammonium nitrate toward mechanical action such as impact, shock and friction and toward the influence of heat it may be concluded that a correspondingly strong initiating agent is required to cause its explosive decomposition. Further, according to the literature, strong confinement seems to be necessary. Prior to the present publication nothing has been known that would indicate the possibility of detonating unconfined ammonium nitrate.

A few references show that it is possible to detonate small quantities of this salt (10 grams) with a strong initiating agent in the Trauzl lead block—that is, under light confinement. Kast (Spreng- und Zündstoffe, 1921, p. 71) reports a net enlargement of 165 c.c. The references cited, both of theoretical calculations and the few reports of the actual behavior of ammonium nitrate as an explosive, do not give, however, an exhaustive picture of its character in this respect.

The measure of explosibility or the strength of the required initial impulse, as well as the energy developed and the velocity of detonation obtained with a certain initial impulse, depend not only on the physical condition of the salt but also to a great degree on the external physical conditions of the experiment. Further, the type of the initiating agent, other things being equal, has an important influence on the initiation and the character of the detonation.

The physical factors that influence the sensitiveness of a crystalline salt toward an initial impulse and thereby toward the ease with which an explosion may be induced are, in general, density, degree of purity and fineness (form and size of crystals; as crystalline powder, fine meal, or fused). The moisture content also is quite important, the more so the more insensitive the salt. A certain measure of the degree of sensitiveness may be indicated by the ratio of the work performed by the salt when detonated by different caps or perhaps by a single cap of definite size, as in the Trauzl test as carried out according to the directions of the International Congress of Applied Chemistry (Berlin, 1913). In this test 10 grams of the substances wrapped in tin foil is fired with a No. 8 cap, sand being used for tamping.

I determined by tests with caps of different size that ammonium nitrate of normal grain size cannot be detonated at all with No. 1 and 3 copper caps, only partly with a No. 6 copper cap, and fully only with a No. 8 copper or Tricinate cap. This indicates offhand that ammonium nitrate can be detonated only with difficulty.

In testing the influence of the degree of fineness—that is, the different sizes of grains—it appears that the enlargement decreased somewhat between certain limits with increasing density of loading. In the same way as with colloidal explosives such as blasting gelatine, a content of air bubbles increases the ease of detonation, the air content of ammonia powders of coarser crystalline structure—that is, lower density—seems to facilitate the propagation of the detonation. If the crystals are very coarse so that the density becomes too small, the blasting effect decreases materially. On the other hand, with ammonium nitrate of the highest possible

density such as is obtained by fusing and solidifying the salt so that there can be no air present to facilitate the propagation of the detonation, detonation occurs practically not at all. The enlargements of the Trauzl blocks obtained with such material (sp.gr. 1.65) indicate only small partial detonations.

Similar observations have been made with other, more sensitive explosives; for instance, crystalline TNT is easily detonated by a cap; cast TNT, on the other hand, requires strong confinement and a heavy initiating agent. Slight caking, however, when moist ammonium nitrate is dried, does not remove the ability to detonate, although it decreases the sensitiveness to some extent. Experiments with ammonium nitrate of varying moisture content show that its explosibility decreases only gradually and that the salt can be considered as insensitive only with a moisture content of 5 per cent or more.

All these results show that the strength of the cap with the density of loading is very important. It must also be taken into consideration that the narrow hole of the lead block and the sand tamping constitute a certain degree of confinement. Further only very small quantities of explosive were used as compared with the amount of initiating agent.

INFLUENCE OF EXPERIMENTAL CONDITIONS

The next step was to determine how larger quantities of ammonium nitrate behave under slight confinement. For this purpose ammonium nitrate in sheet zinc tubes was detonated on lead blocks with different detonators. One No. 8 cap was insufficient to detonate completely 80 grams of the salt thus loosely confined. Only slight explosions, leaving unchanged substance, occurred. With increasing strength of detonator (three No. 8 caps) complete detonation resulted with corresponding compression of the lead block. For comparison, 100 grams of ammonium nitrate in a paper shell was fired with a No. 8 cap, with the result that the salt was simply scattered. The addition of 1 per cent of coal dust or 2 per cent of wood pulp under the same conditions did not bring about detonation, only a slight explosion with some effect on the lead block. The sensitiveness, therefore, is increased by small amounts of organic impurities.

In order to determine further to what degree detonation is initiated and propagated in unconfined ammonium nitrate by increasing the strength of the detonators, long paper cartridges of different diameters lying open on the ground were fired with different detonators. In these experiments, one-half of the cartridge was always found untouched after the shot, indicating that the detonation in unconfined cartridges of moderate diameter (40 to 60 mm.) is propagated only a short distance in the direction of their length and dies out rapidly.

On the other hand, ammonium nitrate packed in cardboard boxes (about 3.5 kg.) could be detonated completely with explosive cartridges (about 100 to 130 grams), giving a sharp report and showing a corresponding amount of energy developed by the earth craters formed. This occurred when the boxes were placed in a hole in the ground as well as when they were simply laid on top of the ground. It also happened not only with ground or finely crystallized, thoroughly dried salt but also with the ordinary technical undried product which contained about 1 per cent of moisture. It may also be mentioned that 12 kg. of ammonium

nitrate packed in a wooden box, 1 meter long and 12 cm. wide, detonated completely with a loud report and the formation of a large, reddish-brown cloud of oxides of nitrogen when fired with 400 grams of compressed picric acid.

All this tends to show that detonation of larger quantities of ammonium nitrate under slight confinement or no confinement at all may be obtained, if only the initial impulse is strong enough.

VELOCITY OF DETONATION

The intensity of the detonation may be expressed by the obtained velocity of detonation, and this was measured according to Dautriche's method. The velocity is dependent, like the explosibility, on a wide number of factors, such as the nature of the initiating agent, the diameter of the tube and the nature of the confinement, the physical conditions and the strength of the initial impulse. This velocity is, therefore, not a physical constant, such as melting point or specific gravity, but is changed by the influence of different physical factors or experimental conditions, although for a given explosive the velocities of detonation so measured always are of a definite order of magnitude.

Experiments along this line showed that the velocity of detonation increases with increasing diameter of the tube and decreases with increasing distance from the starting point and with increasing moisture content. The influence of the initiating agent varies only between moderate limits and corresponds in general to the velocity of detonation of this initiating explosive. With increasing density of loading the velocity increases within the limits practically employed, and it also increases with the strength of the confinement. To test the influence of the type of confinement, experiments were made with thick-walled seamless steel (Mannesmann) and with lead tubing without obtaining serious differences. The appearance of a strong odor of ammonia after the shots in lead pipes leads to the assumption that the lead at the moment of detonation takes part in the reaction, perhaps according to the equation:



The smallest velocity of detonation of dry ammonium nitrate (1,270 meters per second) was obtained with five No. 8 copper caps in a steel tube of 40 mm. diameter, the highest (2,440 to 2,460 meters per second) with compressed picric acid in a lead tube of 50 mm. diameter, respectively, in a Mannesmann tube of 60 mm. diameter.

SUMMARY AND CONCLUSIONS

To summarize the foregoing, it appears that the observed velocity of detonation of about 2,500 meters per second removes all doubt as to the character of ammonium nitrate as a brisant explosive. It is true, it is insensitive and difficult to detonate and cannot be put in the same class as the explosives that are suitable for practical blasting, since it propagates the detonation only under certain conditions—for instance, in large masses, large diameter or strong confinement—whereas a practical blasting powder must propagate the detonation even with a small cartridge diameter and comparatively slight confinement.

On the other hand, the differences are more of degree than of type, as even unconfined ammonium nitrate can be detonated with certainty, although with greater difficulty than when confined, provided that the initial impulse is sufficiently strong. Since this is the case

not only for specially prepared (thoroughly dry, ground or finely crystalline) ammonium nitrate, but also for the raw, somewhat moist, technical product, blasting must not be resorted to in order to loosen caked heaps of this material, as this could easily result in the explosion of the entire mass. In fact, such an explosion occurred 2 years ago in a plant of the Lignose-A.-G. through gross carelessness.

* * *

How the Explosives Industry Regards Ammonium Nitrate

EDITOR'S NOTE: Appreciating the importance of ammonium nitrate to the American explosives industry as well as the fact that its explosibility has been the subject of excellent research in this country, *Chem. & Met.* has asked a number of outstanding authorities to comment on Dr. Aufschläger's conclusions. The reviews that follow may, therefore, be regarded as a survey of expert opinion reflecting briefly the present status of our knowledge of the properties and behavior of ammonium nitrate.

* * *

Some Characteristics of Ammonium Nitrate as Shown by Recent Research

By Charles E. Munroe

Chairman, Committee on Investigation of Explosibility of Ammonium Nitrate

The publication of a translation of Aufschläger's paper under the title "Is Ammonium Nitrate an Explosive?" is most desirable, since, although under ordinary conditions this substance is innocuous, under other conditions and amid certain associations it has given rise to disasters. The fact that ammonium nitrate possess such potentialities should be impressed by continued reiteration upon all dealing with this substance.

Undoubtedly in laboratory experiments of the past two centuries ammonium nitrate must at times have exhibited a restive spirit, yet this was little commented on until the "laughing gas" industry had attained some magnitude. It attracted wider attention when, in the production of ammonium nitrate from the spent acids remaining from the nitration of aromatic hydrocarbons, the material in several instances underwent violent decomposition. It registered itself firmly on the consciousness of man at Oppau.

Following this event a committee was appointed by the National Research Council to study this and other ammonium compounds more closely than appeared to have been done previously with a view of ascertaining, among other facts, the conditions and associations under which NH_4NO_3 develops explosive characteristics. The first step naturally was a review of the literature. The results of this search, combined with reports of some of the more significant accidents, together with descriptions of factory and field tests, were published in *Chem. & Met.*, vol. 26 (1922), pp. 535-542. The research work planned by the committee was carried out by Dr. J. L. Sherrick and the results have been published in *Army Ordnance*, under the titles "Fire Risks With Ammonium Nitrate," vol. 4 (1924), pp. 237-241, and "The Influence of Confinement Upon the Explosibility of Ammonium Nitrate" in vol. 4 (1924), pp. 329-333, while there will be published in the forthcoming issue an article on "The Influence of Density of Packing Upon the Explosibility of Ammonium Nitrate."

Although NH_4NO_3 , *per se* and in admixture with combustibles such as wood pulp and activated charcoal were exposed to the thermit reaction while confined in a tinned can, no explosion occurred in any instance. The heat evolved in the thermal decomposition of a molecule of NH_4NO_3 is theoretically sufficient to effect the thermal decomposition of an adjacent molecule. It fails to do so under the conditions described, because of the character of the heat transference between the solid and gas. Since the reaction evolves a positive quantity of heat, it should be self-sustaining if the entire mass of nitrate be at such a temperature that the heat loss from the system, by conduction and escape of heated gases, is balanced by the heat evolution. This condition appears to have existed in several of the accidents noted. It is more likely to be realized by stronger confinement. Possibly the N_2O formed is first detonated and this then detonates the ammonium nitrate. This is a subject for further study.

VARIOUS DETONATORS TRIED

The detonation of ammonium nitrate was effected by a variety of initiating agents used as detonators or boosters. The most efficient initiator was a dynamite containing 78 per cent of NH_4NO_3 , 9 per cent of nitroglycerine and 12 per cent of a carbonaceous nitrate dope, but its detonation was also effected by a single No. 8 detonator. The susceptibility of NH_4NO_3 to initiate detonation and its capacity to propagate detonation are affected by the extent to which it is confined and the degree to which it is comparted. In no case was it found possible to cause unconfined NH_4NO_3 , at the ordinary temperature, to detonate, but when confined in metal tubes it was detonated by several of the initiators employed. The certainty with which detonation could be effected increased with the degree of confinement. The certainty of initiating detonation decreased, on the other hand, with an increase in the density of the ammonium nitrate—that is, the salt tended to become "dead pressed." In any event, the detonation or explosion wave initiated in ammonium nitrate is propagated with diminishing rate and intensity as it proceeds through the mass. The distance to which this wave is propagated depends upon the rate and intensity of the induced wave and upon the extent of confinement and the density of the ammonium nitrate.

The results obtained by Sherrick are quite in agreement with those presented by Aufschläger, except as to the initiating of explosions in unconfined or rather lightly confined masses of NH_4NO_3 , as in Aufschläger's cardboard box tests. We are not informed as to the character of the explosive in the cartridges (about 100 to 130 grams) he used, but where he employed picric acid as the initiating agent he used four times as much as Sherrick did. Moreover, it would appear that his picric acid was well confined in a lead tube, through which it could develop its highest efficiency as an initiating agent. These results are quite to have been expected and the warning Aufschläger gives regarding the danger of blasting in caked ammonium nitrate should be regarded.

Reference has been made here to the temperature of the ammonium nitrate at the time of testing, for in the tests previously reported in this magazine, as above referred to, it was shown that heated, unconfined, ammonium nitrate was relatively sensitive to detonation by initiating agents, but it was also observed here that the detonation wave failed to propagate it-

self to any considerable distance within the nitrate.

From all the evidence thus far obtained we may still hold that ammonium nitrate offers much the same fire hazard as sodium nitrate, and that when packed by itself in wooden receptacles and apart from explosive substances it is, for the purposes of transportation and storage, not an explosive.

* * *

Agrees With du Pont's Experience

By J. Thompson Brown

General Manager, Explosives Department,
E. I. du Pont de Nemours & Co., Inc.

We have reviewed the article, "Is Ammonium Nitrate an Explosive?" and find that the data given are in general agreement with the results of our own tests and experience. We consider the whole article a very fair statement with regard to the properties of ammonium nitrate.

* * *

Ammonium Nitrate by Itself Is Not an Explosive

By G. N. Norman

Technical Director, Hercules Powder Co.

I consider that ammonium nitrate is not an explosive by itself, because millions of pounds of it have been and are now being made every month in Europe and in this country. To the best of my knowledge no major accident has ever resulted during the course of such manufacture, except where other compounds have been present, such as TNT or other nitrated organic bodies.

Ammonium nitrate, in my opinion, does not constitute anything more than a fire hazard when handled by itself. In combination with other materials, a sensitive high explosive may be formed, but the same is true of sugar, flour, gasoline and illuminating gas, as well as the hundreds of industrial dusts, such as aluminum powder. Yet these materials are not ordinarily considered explosive, with the possible exception of gasoline. Because ammonium nitrate is used largely as an ingredient in high explosives, the natural tendency is to consider it is a high explosive itself. Such a view, in our opinion, is entirely erroneous.

* * *

Nixon Explosion Emphasizes Effect of Organic Impurities

By R. I. Bashford

Vice-President, Peerless Explosives Co., Wilkes-Barre, Pa.

During the past 8 years there has occurred in the United States a number of explosions involving ammonium nitrate while undergoing its manufacturing processes. Oftentimes slight fires occur in the evaporator, especially after the bulk of the charge has been drawn to the graining kettles and small amounts remain in the evaporators that are very prone to overheating. It is always during the later stages of the evaporation that fires occur, but in every case under the observation of the writer there has always been some organic or carbonaceous material present. In the case of the carbonaceous material when the fire does not become serious, charred material usually can be found as direct evidence.

In the recent accident at Nixon, N. J., the presence of relatively small amounts of TNT in the liquor and in the finished product can be readily accounted for and presumably had been a matter of general knowledge. Furthermore, it should not be forgotten that carbonaceous material in a very finely divided state may have been present due to improper functioning of the sand

filter. I refer to the use of carbonaceous materials for removing impurities and color. Such carbonaceous material would tend to sensitize the nitrate of ammonia to explosive influences.

At Nixon the evaporation was carried on under a vacuum and the concentrated liquor was usually withdrawn from the evaporators and run to the vacuum grainers at a temperature between 105 and 125 deg. C. The water content at this temperature usually ranged around 5 per cent. At such a concentration and temperature it would, I believe, be impossible to detonate the pure material under any conditions that can be reasonably conceived as having existed.

The grainers were of the standard type usually used for this work by practically all American manufacturers of ammonium nitrate. Heat for driving out excess moisture was applied to the crystallizers by means of steam at 80 lb. pressure. It is quite possible that a charge in the crystallizer grainer became dry and overheated and finally fired with the resultant detonation or it may have become overheated and detonated without firing. The presence of TNT or carbonaceous material would, I believe, under the conditions present, fire quite readily if a small portion of the material was in a dry state and was allowed to remain for a sufficient interval in contact with a metallic surface at a temperature that would exist at the indicated boiler pressure.

Private experiments indicate that nitrate of ammonia of the degree of fineness usually used by manufacturers of high explosives is very difficult to detonate, but that it can be detonated by fulminate caps, and furthermore that the sensitiveness to detonation is considerably increased by relatively small amounts of carbonaceous material.

I know of no explosion of nitrate of ammonia in the United States in which the evidence did not tend to prove the presence of other organic nitrates or carbonaceous materials.

If the evaporation is carried on at a temperature not in excess of 310 deg. F., acidity of the charge during the evaporation is prevented and efficient agitation of the charges maintained, it is my opinion that the likelihood of an accident is most remote.

The German disaster at Oppau undoubtedly was due to entirely different conditions. At least one German authority holds the opinion that blasting of the storage piles caused the main mass to detonate, and this explanation seems to be a most reasonable one. In this connection the warning contained in the last few sentences of Aufschläger's article is particularly well worth reading.

* * *

Rates of Detonation Are of Scientific Interest

By C. G. Storm

Chief, Explosives Section, Ammunition Division,
Ordnance Department, United States Army

I have read Dr. Aufschläger's article with much interest. The values reported for the experimentally determined rates of detonation of ammonium nitrate are of particular interest, as, so far as I am aware, no actual results of such tests have been published. That is practically the only novel feature of the article. That ammonium nitrate, under sufficiently strong confinement and with an initial detonating charge of suitable strength, can be made to detonate has been fully demonstrated.

Fire and Explosion Risks With Ammonium Nitrate

EDITOR'S NOTE: Following are the conclusions reached by Dr. J. L. Sherrick in the first and second reports on the work of the committee of the National Research Council conducted in co-operation with the United States Bureau of Mines. These are reprinted from *Army Ordnance*, vol. 4, Nos. 22 and 23, pp. 237-41 and 329-33 (1924):

FIRE HAZARDS

1. Ammonium nitrate is not combustible, in the sense that such term is ordinarily used.

The reaction of thermal decomposition, initiated at a point in a mass of the salt at room temperature, will not sustain itself.

It seems obvious that, since the reaction of thermal decomposition evolves a positive quantity of heat, it will be self-sustaining if the entire mass of nitrate be at such a temperature that the heat loss from the system, by conduction and escape of heated gases, is balanced by the heat evolution.¹

2. Ammonium nitrate supports the combustion of oxidizable materials.

Its ability to support combustion in any given case will depend upon the initial temperature of the system under consideration, as a whole; the quantity of combustible matter in proportion to the amount of ammonium nitrate; the intimacy of admixture of the combustible matter and the nitrate; and the nature of the combustible material as regards its temperature of ignition, its evolution upon combustion and the nature and heat capacity of its combustion products.

3. In the tests reported, it was not found possible to bring about the detonation of ammonium nitrate by the application of fire or heat.

4. The importance of studying the decomposition of nitrous oxide and the effect of such decomposition upon the sensitiveness of ammonium nitrate to detonation is indicated by theoretical considerations.

INFLUENCE OF CONFINEMENT

1. Confinement is very effective in promoting the detonation of ammonium nitrate charges.

2. The detonation of ammonium nitrate appears to be the result of an induced wave of detonation from the booster or initiator, and such wave is propagated with diminished rate and intensity as it proceeds. The distance to which the wave is propagated depends upon the rate and intensity of the induced wave and certainly also upon the degree of confinement of the nitrate charge.

3. From the standpoint of their efficacy as boosters for ammonium nitrate, the various explosives may be graded as follows: High content ammonium nitrate explosive (nitroglycerine 9 per cent), TNA, picric acid, tetryl, TNT, 60 per cent gelatin dynamite, 40 per cent ammonia dynamite, amatol 80/20; high content ammonium nitrate explosive being the most efficient and amatol 80/20 being the least efficient.

4. The influence effect, assumed in the "synchronous vibration" theory of detonation, is not apparent in the efficiency grading based on the experimental results of this investigation.

¹This conclusion agrees with the facts observed by C. A. Bigelow, of the Hercules Powder Co. and M. B. Cheney, of the Ohio Chemical & Manufacturing Co., in connection with the accidental decomposition of ammonium nitrate during manufacturing processes.

A Survey of Products That Afford Industrial Outlets for Chlorine

This Final Article Discusses Hydrochloric Acid and Organic Compounds as Methods of Consuming Chlorine on a Commercial Scale

By Paul S. Brallier

Chemical Engineer, Niagara Falls, N. Y.

THE manufacture of hydrochloric acid from chlorine by direct reaction with the byproduct hydrogen of the chlorine cell has afforded the chlorine producer an outlet for a portion of his gas. Production for sale and price data for hydrochloric acid are given in the following table. The production is total production for sale, and includes acid made by the salt-sulphuric acid process:

20° Bé. Hydrochloric Acid—Production and Price Data

Year	Production Tons	Approx. Average Price, Cents Per Lb
1914	85,438	0.8
1917	.....	1.81
1918	.....	2.50
1919	150,090	2.19
1920	.....	1.71
1921	95,900	1.45
1922	.....	1.14
1923	.....	1.05

The prevailing practice in this country for the synthetic process has been outlined by Moore (41)* in his description of the Brown Co. acid plant. Chlorine and hydrogen gases are conducted through separate lines to a brick-lined steel box that comprises the combustion chamber. An excess of hydrogen is used. The hot hydrochloric acid gas produced in the burner is passed through a fused silica atmospheric cooler and a water-cooled earthenware coil, and then into an absorption system. Air is admitted with the chlorine to reduce the burner temperature, but the hydrogen system is kept under a slight back pressure to prevent air leakage. A blower with porcelain rotor is used to exhaust the system and draw in hydrogen and chlorine. Townsend has obtained U. S. patent 1,414,762 on a modification of this system.

Niccoli in British patent 159,869 describes a process very similar to the above. He uses quartz hydrogen and chlorine supply lines, maintains a safety pilot flame of hydrogen in the burner, and has the hydrogen and chlorine supply pipes face each other to insure intimate mixture of the gases.

French practice is slightly different. The two gases are forced under pressure through porous diaphragms, an excess of hydrogen is mixed with the chlorine, and the mixture is exploded by being brought into contact with incandescent carbon or platinum. Small and simple explosion units are used (42). A similar process is described by Waldesbühl in Swiss patent 77,537.

Mathieu (42) has studied the explosive limits of

hydrogen and chlorine gas mixtures, and finds that when exposed to the radiation from an induction coil spark, explosion occurs only when the composition of the mixture is between 91.9 per cent by volume chlorine and 8.1 per cent hydrogen, and 14.3 per cent chlorine and 85.7 per cent hydrogen. When exposed to radiation from a magnesium flame, the limits are 90.2 per cent Cl_2 , 9.8 per cent H_2 , and 47.5 per cent Cl_2 , 52.5 per cent H_2 .

Combination of hydrogen and chlorine in the presence of certain catalysts has been studied by Neumann (44). He confirmed previous statements that reaction between hydrogen and chlorine is promoted by concentrated solutions of zinc, aluminum and tin chlorides, but that a conversion of only 70 per cent is obtained. When MgCl_2 , CaCl_2 , or Al_2Cl_3 was coated on quartz and this material was first ignited at 400 deg. in the mixed gas, a practically complete conversion could be obtained by passing the gas mixture over it at 300 to 380 deg. C.; only, however, when the gas velocity was low. MgCl_2 was effective at 300 deg., CaCl_2 at 305 deg., and Al_2Cl_3 at 350 deg. Pure quartz gave complete conversion, but not until a temperature of 380 deg. The presence of water is absolutely necessary in at least the proportion of 1 molecule of water per molecule HCl . The addition of air to the gas mixture did not cause contamination of the HCl with chlorine, as might be expected.

Garner and Clayton in U. S. patent 1,220,411 have described a process along the same lines. They bring a mixture of hydrogen and chlorine in the proportion of 50 volumes of H_2 to 35 volumes Cl_2 into contact with wood charcoal at 340 deg. C. or higher in the presence of moisture.

Peter has obtained U. S. patent 1,229,509 on a process of mixing 3 parts by weight of chlorine with 7 parts water, and passing the mixture over carbon or sulphur at about 200 deg. Coke or charcoal is said to be preferable. Gibbs (45) has stated that the action of chlorine on water and charcoal at temperatures of 0 to 130 deg. C. produces CO_2 and HCl , the speed of the reaction depending on temperature, the charcoal used, and relations between concentrations of water and chlorine.

Averill (46) has proposed the burning of natural gas in an atmosphere of chlorine to form HCl and lamp black. Rumbarger chlorinates natural gas and a liquid hydrocarbon such as fuel oil, kerosene or gasoline in a chamber that may contain a catalyst, and after washing out the HCl , uses the remaining gas, having an increased carbon content, for burning in a lamp black plant.

*Figures in parentheses refer to bibliography at end of article.

Various modifications of the general process of causing chlorine, sulphur dioxide and steam to react to form HCl and H_2SO_4 are described in U. S. patents 1,285,856 to H. V. Welch; 1,325,711 and 1,325,712 to E. D. Chaplin; 1,332,581 to H. Tobler; and 1,430,035 to W. O. Snelling. So far as is known, this process is not in use.

Chlorine may be used in making KMnO_4 to oxidize the manganate obtained by heating together finely ground MnO_2 and ground caustic soda. The manganate, containing an excess of caustic soda, is dissolved to form a solution with a specific gravity of 1.18 (47). Chlorine is then bubbled through the solution, the hypochlorite formed by reaction with the excess NaOH serving to bring about the oxidation to permanganate; 100 lb. permanganate requires the use of about 22 lb. of chlorine.

ORGANIC PRODUCTS

Among other products which the chlorine manufacturer has included in his list may be mentioned benzyl chloride, benzaldehyde, benzoic acid, mono- and di-chlorobenzol, ethylene dichloride, acetylene tetrachloride, ethyl chloride, and monochloroacetic acid. Phosphorous trichloride is also produced, but there has been no recent information published as to the method of its manufacture.

Benzyl chloride is usually obtained by direct chlorination of toluene at its boiling point. Lower temperatures favor the introduction of chlorine into the ring rather than the side chain. Loomis in U. S. patent 1,384,909 claims that when toluene is chlorinated in the presence of an alkali metal carbonate, the reaction is more rapid, corrosion due to the resultant gases is minimized, and relatively small amounts of nuclear chlorine compounds are produced.

Gibbs has stated (48) as a result of the studies of the chlorination of toluene in the vapor phase, using ultra-violet light as catalyst to form benzyl chloride, benzal chloride and benzo-trichloride, that the extent of chlorination can be controlled to some degree by the character of the light, the relation between the reacting gases, and the temperature. Low-pressure quartz mercury lamps tend to produce mostly benzal chloride, while high-pressure lamps produce more benzo-trichloride.

Benedetti, Vanselow and Vanselow in U. S. patent 1,405,261 claim a process of making benzaldehyde by hydrolyzing benzyl chloride to benzyl alcohol by refluxing for several hours with NaOH solution, and treating the product so obtained with sodium hypochlorite solution containing not over 2 to 3 per cent NaOH . The aldehyde is separated during the hypochlorite addition by steam distillation. Another process consists in heating together benzyl bromide and sodium nitrate solution (49). The use of the bromide is said to give a more nearly pure benzaldehyde, with sodium bromide as a byproduct. Benzaldehyde is said to be made commercially by direct hydrolysis of benzal chloride with limewater.

Very closely related to benzaldehyde is the manufacture of benzoic acid by the use of chlorine. According to McKee and Strauss (50), benzyl chloride is usually the base material in American practice. The benzyl chloride is simultaneously hydrolyzed and oxidized by a warm slurry of bleaching powder. German manufacturers usually start with benzo-trichloride, which may be decomposed with milk of lime in the presence of iron powder; or hydrolyzed with water under pressure at 140 to 190 deg. C.; or boiled with alkali. McKee and Strauss have developed a process for making benzoic acid from benzene wherein benzonitrile is formed and hydrolyzed to yield benzoic acid.

Monochlorobenzol is prepared by the direct chlorination of benzol in the presence of certain catalysts. No production figures have been found for this product. The approximate price variation over the past 7 years is given in the following tabulation:

Monochlorobenzol—Approximate Average Price

Year	Cents Per Lb.
1917	26.9
1918	19.1
1919	13.8
1920	17.2
1921	13.5
1922	11.0
1923	9.0

French patent 480,151 covers a process of exposing a surface of benzol to the action of chlorine, iron or other catalyst being suspended or dissolved in the benzol. The benzol, catalyst and chlorine are all kept in motion relatively. Another French patent, 482,372, outlines a process in which benzol is saturated with chlorine and passed up through a column containing iron turnings, the reaction taking place immediately. The liquid flowing from the apparatus contains about 30 per cent mono-

Hydrochloric acid as an outlet for chlorine is a reasonable novelty, but is assuming commercial significance. Then there are a large number of organic compounds that need chlorine in their process of manufacture, although the finished product contains no chlorine. This article completes the survey of outlets for chlorine and with the two others presents an intelligent picture of the present methods of utilization of the immense chlorine capacity of the country — or rather, of that part of it that is utilized.

chlorobenzol and 1.8 per cent polychlor products. Smythe (51) has found that substitution and addition take place when benzol is chlorinated in the presence of CaCl_2 . The reaction product contains mono- and di-chlorobenzol and two isomerides of $\text{C}_6\text{H}_4\text{Cl}_2$, the yield of the latter being considerable.

Paradichlorobenzol was for some time a comparatively useless byproduct in the manufacture of monochlorobenzol. Its status has changed, however, since it was found effective against the peach-borer. Konantz has suggested (52) that it may supplant naphthalene as a moth repellant; and also that when dissolved in benzine or CCl_4 and applied as a spray to joints of woodwork or clothing, it may prove effective against various insects and their eggs or larvæ.

The combination of ethylene and chlorine to form ethylene dichloride is brought about very readily in the presence of CaCl_2 , according to Smythe (51). When ethylene is kept in slight excess, the dichloride is the main product, although some trichlorethane is also

formed. This latter product may be separated readily by fractional distillation. Curme (56) states that ethylene chloride is best made by mixing dry ethylene and liquid chlorine at temperatures below 0 deg., and at a pressure corresponding to the vapor pressure of the chlorine. At higher temperatures higher chlorinated compounds are formed. The commercial product is very pure and boils sharply.

Acetylene tetrachloride is made by the direct union of acetylene and chlorine gases. The reaction is accompanied by the liberation of heat, and unless the temperature is carefully controlled, may proceed with explosive violence and with formation of free carbon and HCl. The Swedish practice is to bring in chlorine and acetylene on opposite sides of an upright steel box about 9 in. thick, 4 ft. high, and 6 ft. long. The box is filled with coarse sand and the temperature is controlled by keeping the sand wet with circulating acetylene tetrachloride. This solvent was used quite extensively during the war, especially in airplane varnish. Its objectionable features are that it is more readily decomposed by water than most other chlorinated hydrocarbons, and is consequently more corrosive; and that its vapors are injurious to health. Trichlorethylene, prepared from acetylene tetrachloride by hydrolysis with limewater, is superior to it in these respects, and is used extensively abroad.

Ethyl chloride has come into favor as a refrigerating agent, especially on board ships. A relatively large compressor is required when ethyl chloride is used as a refrigerant; but this is more than balanced by the fact that for most purposes the highest pressure developed in the system is 15 lb. per square inch. Ethyl chloride may be prepared by the action of HCl, or of a mixture of substances capable of generating HCl, upon ethyl alcohol (58). The production of ethyl chloride in 1919 was 248,103 lb., valued at 67 cents per pound; and in 1921, 208,300 lb. valued at 65 cents.

Chloroacetic acid results from the action of chlorine on acetic acid under certain conditions, and is said to be made commercially by the action of chlorine on acetate of lime. Custis (53) has found that acetic acid and chlorine react at the temperature of the steam bath to form monochloroacetic acid under the influence of the iron arc, without the presence of a catalyst. The yield is increased when red phosphorus is used as catalyst. Chlorination does not proceed under the influence of rays from a projection lantern, nor does chlorine activated by rays from a mercury arc react with acetic acid. Chloroacetic acid is formed by the action of 100 parts trichlorethylene on 450 parts 92 per cent sulphuric acid at 160 deg., the product being separated by distillation. If desired, ethyl alcohol may be added to the mixture to obtain directly the ethyl ester (54). According to U. S. patent 1,322,898, chloroacetic acid is produced continuously by the action of trichlorethylene upon sulphuric acid of at least 90 per cent strength. The concentration of the acid is kept within the proper limits by addition of water, and the chloroacetic acid is removed from the reaction zone by a current of trichlorethylene vapor.

The preparation of chlorhydrins and glycols received a great deal of attention during the war and for several years after. Numerous patents have been granted covering the general processes of bringing about reaction between olefin hydrocarbon gases and hypochlorous acid; or of acting upon olefin hydrocarbon gases with chlorine to form chlorides, which are subsequently

hydrolyzed, or with a mixture of chlorine and steam to bring about chlorination and hydrolysis at once. So far as is known, these compounds are not being prepared in any considerable quantity at present.

A very recent development that may prove to be of interest to the chlorine manufacturer is the process of McKee and Burke (55) for making methanol from methyl chloride. The methyl chloride vapor, mixed with water vapor to the extent of 350 to 450 mm. partial pressure, is passed over calcium hydroxide heated to 350 deg. C. The products of the reaction are methanol and methyl ether. The methyl ether may be converted to methanol by hydrolysis.

This rather prolonged discussion covers the more important developments in the manufacture and uses of chlorine and chlorine products, as disclosed in the periodical and patent literature of the past few years. If it summarizes and brings together for the worker in chlorine the random articles that he has read from time to time, and if it gives the general reader some idea of the range and nature of the problems with which the chlorine manufacturer has to deal, it will have accomplished its purpose.

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Effect of Heat Value on Usefulness of Gas

For several years California authorities and the gas companies of that state have joined in studying the influence of standards for gas quality on usefulness to the customer. Lester W. Ready, chief engineer of the California Railroad Commission, has recently reported on some of the conclusions from this work. (*Gas Age-Record*, April 5, page 419.)

"The change in the use of gas resulting from the introduction of natural gas of 1,000 B.t.u. or more in place of manufactured gas has uniformly shown a reduction in use very nearly equivalent to the increase in heat content. A recent change in gas quality at Santa Barbara of from 550 to 700 B.t.u. per cubic foot, an increase of 27.3 per cent, will no doubt produce some interesting figures. There has not been sufficient time to derive over-all figures for all consumers, but a tabulation has been made of fourteen downtown restaurants using gas for general top burner and baking operations. During the last week of the 550 B.t.u. gas these restaurants had a combined use of 195,300 cu.ft. and in the first week of the 700 B.t.u. gas a combined use of 152,400 cu.ft., a decrease of 21.9 per cent. The average weekly use for 4 weeks prior to the change in quality was 196,900 cu.ft. and for the 4 weeks following the change was 155,900 cu.ft., or a decrease of 20.8 per cent."

Chromium-Plating Steel

Investigation of This Remarkable Protection Against Corrosion

By Kevie W. Schwartz

Columbia University, New York City

THE property of metallic chromium of retaining its silver-like luster indefinitely even in a chemical laboratory is typical of the corrosion resistance of this metal. Its resistance to certain unusual corrosives, as for instance certain molten metals, is even more remarkable. It is not surprising, therefore, that chromium plating has been studied for many years. But the reports of previous investigators fail to agree on many important points.

On account of this wide diversity of results and opinions it was decided to study:

1. The effect of chromium sulphate concentration at various current densities.
2. The effect of hydrogen ion concentration.
3. The effect on the deposit of substituting chromium anodes in place of lead and of platinum anodes.
4. The extent of the passivity of the chromium anodes after prolonged electrolysis.

The electrolytic corrosion of the chromium deposit, as compared with other metals and alloys, in such media as concentrated nitric acid, dilute nitric acid, sea water, molten tin, zinc and brass, was also investigated.

After eliminating many solutions and methods of procedure as unsatisfactory, a series of runs was made, varying the concentration of the chromic acid, but keeping the content of chromium sulphate and the current density constant. It was found that good deposits could be got on iron, using chromium anodes, anywhere within the range from 200 to 400 grams per liter of chromic acid. The best concentration was found to be 245 grams per liter chromic acid plus 3 grams per liter chromium sulphate, which solution was designated as "C."

GOOD DEPOSITS OBTAINED

Using this solution, the effect of current density was determined over the range from 2.7 to 54 amp. per sq.dm. (25 to 500 amp. per sq.ft.) Good deposits were obtained up to about 16 amp. per sq.dm. (150 amp. per sq.ft.) Above this the deposits were dark at first and after continued plating showed signs of cracking. The best current density to use for a bright adherent deposit proved to be between 10.8 and 13.4 amp. per sq.dm. (100 and 125 amp. per sq.ft.), with the electrolyte at room temperature. See table I.

Using the same solution, a run was made to study the effect of temperature. The current density used for the room temperature run was 13.4 amp. per sq.dm. (125 amp. per sq.ft.) The deposit was satisfactory. On making a run at 55 to 60 deg. C. and the same current density, no plate resulted after 2 hours operation, although the evolution of hydrogen at the cathode was

quite rapid. However, upon doubling the current density a good plate resulted at this higher temperature.

In the successful experiments a single cell was used. This consisted of a 600-c.c. beaker with two anodes (usually chromium) suspended in the solution, preferably by means of chromium-plated iron wires. The anodes of chromium were prepared by the Goldschmidt process. They were approximately 5x3.7x3.7 cm. (2x1.5x1.5 in.) in size. The chromium sulphate and chromic acid used were Eimer & Amend's "chemically pure grade." All solutions were filtered before using. Cold chromic acid solutions have little or no effect on the filter paper. The iron cathodes were electrolytically cleaned.

Exposure for weeks to the corrosive atmosphere of the laboratory produced no effect on the chromium plate, whereas iron corroded rapidly. Chromium-plated iron immersed in tap water for 3 weeks showed no signs of

losing its luster or of a tendency to corrode. Dipping the chromium plate into hot sulphuric acid or hydrochloric acid caused it to dissolve. Boiling it in hot concentrated nitric acid for 2 hours produced no appreciable effect on the chromium plate.

A series of corrosion tests on various metals in order to compare them with chromium plate under similar

conditions was then undertaken. These consisted in exposing weighed samples in closed containers to air saturated with (a) ammonia, (b) hydrochloric acid, (c) nitric acid, and (d) hydrogen sulphide fumes for 192 hours. At the end of this period the samples were again weighed and the loss or gain in weight per unit of surface per year was calculated. These are listed in Table II.

This table shows that the chromium plate stands up well in ammonia vapor, nitric acid fumes and hydrogen sulphide fumes. It is practically on a par with Duriron on exposure to nitric acid fumes. Hydrochloric acid vapor attacks chromium almost immediately.

Experiments showed that chromium does not stand up under electrolytic corrosion nearly as well as it does under atmospheric corrosion. Of the materials tested—namely, chromium-plated iron, ordinary iron, aluminum and Duriron—the last showed smallest loss due to electrolytic corrosion.

I attribute the inability of chromium-plated steel to withstand electrolytic corrosion to a "breakdown" of the protective surface film by the action of the electric current. With the aid of the current the acid ions will pass readily through the surface film and attack the virgin metal beneath, whereas in the case of atmospheric cor-

Since a recent article on chromium called attention to this metal's remarkable ability to resist certain types of corrosion many requests have been received for more information in regard to chromium plating. Mr. Schwartz's article gives the detailed information necessary for the production of a successful chromium plate.

Table I—Effect of Current Density on Deposit

Solution: 245 grams per liter, chromic acid, plus chromium sulphate, 3 grams per liter. Room temperature. Anodes, chromium. Cathode, Fe, with exposed surface of 1 sq.in. No mechanical stirring.

Sample	Time, Min.	C. D. amp./sq.ft.	Voltage	Description of Deposit
1	120	90	2.3	Crystalline and adherent
2	60	45	2.3	Surface barely covered
3	120	125	2.5	Very good, bright, adherent
4	120	144	2.5	Gray, crystalline
5	60	345	2.9	Dull, adherent, tendency to form yellow coating
6	120	540	3.5	Gray at first, then turned yellow and finally cracked

Table II—Corrosion Tests in Air Saturated With Vapors

(a) Ammonia Vapor		(b) Hydrochloric Acid Fumes	
Sample	Loss in Grams/sq. cm./yr. Gained in wt.	Sample	Loss in Grams/sq. cm./yr. Gained in wt.
Cu.....	zero	Cu.....	120
Fe.....	zero	Fe.....	1262
Cr on Fe.....	zero	Al.....	377
Al.....	45	Duriron.....	70
(c) Conc. Nitric Acid Fumes		(d) Hydrogen Sulphide Fumes	
Sample	Loss in Grams/sq. cm./yr.	Sample	Loss in Grams/sq. cm./yr.
Al.....	19.4	Fe.....	23.6
Fe.....	2290	Duriron.....	Gained in wt.
Duriron.....	10	Al.....	7.1
Cr on Fe.....	11.8	Cr on Fe.....	Slight gain
Ni.....	475		

rosion the migration of the acid through the film is extremely slow in comparison.

Under the microscope the chromium plate is uniform and free from holes due to occluded gases.

Chromium plate has wearing qualities and hardness superior to ordinary iron, galvanized iron and tinned iron.

Chromium-covered iron is not attacked by molten tin, zinc or brass, whereas ordinary iron disintegrates rapidly.

CONCLUSIONS

1. Good, adherent deposits of chromium on iron were obtained, using solutions containing 3 grams per liter chromium sulphate and from 200 to 400 grams per liter chromic acid.

2. The cathode current density range for good deposits was found to be from 9.3 to 16 amp. per sq.dm. (100 to 150 amp. per sq.ft.)

3. Best results were obtained using Sargent's solution containing 3 grams per liter chromium sulphate, 245 grams per liter chromic acid, and a current density of 13.4 amp. per sq.dm. (125 amp. per sq.ft.) The anodes used were chromium. The solution was at room temperature and stirring in addition to that caused by the evolution of hydrogen was found unnecessary.

4. Chromium anodes in the above solution show no tendency to become passive even after long and continuous plating operations. Chromium anodes are cheaper than platinum and better than lead.

5. The simultaneous evolution of hydrogen with chromium deposition on iron is essential to good results. The hydrogen appears to protect the freshly discharged metal and to counteract the great tendency of chromium to pass back to the chromous ion stage. This tendency is particularly marked in the strongly oxidizing medium of chromic acid.

6. Chromium-plated iron and steel has a hard, bright, silver-like surface.

7. Chromium-plated iron and steel resist atmospheric corrosion indefinitely.

8. Chromium-plated iron and steel are resistant to the action of fumes of nitric acid, hydrogen sulphide and ammonia. They also resist the corrosive action of molten tin, zinc and brass.

9. Steel does not lose its temper during chromium plating.

10. Chromium-plated iron does not resist electrolytic corrosion in mineral acids.

The writer wishes to express his sincere appreciation to Prof. Colin G. Fink, under whose direction this investigation was carried out, and also to Prof. William Campbell and Dr. E. P. Polushkin for many valuable suggestions.

Felt Roofing Specifications Promulgated

Specifications officially adopted by the Federal Specifications Board on Dec. 29, 1923, are now in effect to control government purchases of asphalt saturated and coal-tar saturated rag felt for roofing and waterproofing purposes. These two specifications are covered by circulars 161 and 156 of the National Bureau of Standards, recently issued. They are designated as government standard specifications No. 86 and No. 81, respectively. The methods of sampling and testing are given in detail in the circulars named. The specifications that are common for the two kinds of material are as follows:

(a) Appearance—It shall be free from visible external defects and uniform throughout. When unrolled at temperatures between 50 and 90 deg. F. it shall not stick to such an extent as to cause tearing.

(b) Width—32 or 36 in. $\pm \frac{1}{4}$ in.

(c) Gross Weight of Roll—50 to 80 lb.

(d) Weight of Wrapping, Packing, Etc., Per Roll—Maximum $\frac{1}{4}$ lb.

(e) Weight Per 100 Sq. Ft., Exclusive of Packing, etc.—14 lb., ± 1 lb.

(f) Pliability at 77 deg. F.—No cracking on bending flat on itself.

(g) Average Breaking Strength—With fiber grain, 30 lb.; across fiber grain, 15 lb.

(i) Ash of Desaturated Felt—Maximum, 8 per cent.

(j) Packing and Labeling—The felt shall be properly wrapped and labeled with the manufacturer's name, brand, grade, weight, area of roll, and type of saturant.

The following additional requirements are made for asphalt saturated felts:

(h) Loss on Heating at 221 Deg. F.—Maximum, 4 per cent.

(i) Weight of Moisture-Free Desaturated Felt Per 100 Sq. Ft.—Minimum, 5.2 lb.

(j) Weight of Saturant Per 100 Sq. Ft.—Minimum, 1.4 times the weight of moisture-free felt per 100 sq. ft.

(k) Weight of Comminuted Surfacing Per 100 Sq. Ft.—Maximum, 1 lb.

(l) Ash of Desaturated Felt—Maximum, 8 per cent.

The additional specification, required only for coal-tar saturated felts, is thickness of desaturated felt, which must exceed a minimum of 0.025 in.

Michigan's New Lab Completed

A recent communication from the department of chemical engineering at the University of Michigan states that the new engineering building has been completed. Seventy-five rooms, with a total floor area of 60,000 sq.ft., are devoted to chemical and metallurgical engineering.

In the general laboratory facilities are afforded for unit process investigations, including evaporation, distillation, gas absorption, filtration, crystallizing and stirring and mixing. The equipment available is complete in variety with installations of much semi-commercial-scale apparatus. In addition special laboratories have been provided for industrial work on ceramics, pulp and paper, paint and varnish, petroleum and motor fuels, dyes, textiles and leather, electrochemical products, and gas.

A bulletin has recently been issued by the university (vol. 25, No. 26) that contains a complete description of the new laboratory as well as an announcement of the various courses in chemical engineering now given.

Developments in Recovering Byproducts From Coke-Oven Gases

Trends in European Practice Will Serve to Show the American
Oven Operator What the Future May Hold for His Industry

By E. V. Espenhahn

East Orange, N. J.

RECENT improvements in byproduct recovery have been limited to engineering and construction features. Methods have remained virtually unchanged since the introduction of the direct and semi-direct methods of ammonia recovery, which was before the byproduct coke oven itself was seriously thought of in this country. It is not to be denied that these processes are very efficient, requiring but little labor for their operation and representing a considerable improvement over indirect absorption methods. The capital investment is equally favorable.

These direct processes do not, however, take into consideration the sulphur that is contained in the gas. On scrubbing the gases with water for the removal of ammonia, as much as 30 per cent of the sulphuretted hydrogen is also absorbed and is made available in concentrated form after distilling the ammoniacal liquor. To avoid contaminating the atmosphere, this is absorbed by iron oxide, the same means that is employed for the removal of the remainder of this impurity from the gas. In Europe this spent oxide, containing about 45 per cent available sulphur, is used for the manufacture of sulphuric acid, which is returned to the gas-works for the manufacture of ammonium sulphate. The returns from this sulphur contribute toward the expense of removing the hydrogen sulphide, which amounts to from 1.5 to 3 cents per 1,000 cu.ft. In this country it is probably more economical to introduce the sulphur for the manufacture of sulphate from outside sources in the form of sulphuric acid, in spite of the extra bulk and at times the long haulage involved.

In this paper it is intended to review from a chemical engineering standpoint processes that have been suggested for utilizing more fully the various byproducts in coke-oven gases now wasted; not only as regards the sulphur, but also such constituents as cyanides, ethylene, etc. These processes have for the most part originated in Europe and were being perfected when the late war began. Circumstances since then have not been propitious for experimentation with and exploitation of new processes.

Referring to the Mineral Resources publications of the Geological Survey, it will be seen that the production of ammonium sulphate from coke ovens during the

year 1920 was approximately 338,000 tons, but sank to 264,000 during the following 12 months; for the year 1922 a production of 381,000 tons may be assumed from the calculated coke output. The past year has undoubtedly seen a further increase, and with one large installation of byproduct ovens nearing completion, a production of at least 400,000 tons may be expected in the future. In the manufacture of this product an equal quantity of 60 deg. Bé. sulphuric acid will be used. Assuming an average price of \$11 per ton landed at coke ovens, about \$4,500,000 will be spent for acid, a commodity that it is possible largely to replace by the sulphur of the coke-oven gas itself. The saving

made by this substitution will be greater for plants situated at considerable distances from acid plants, so that the possibilities of sulphur utilization should appeal especially to them.

Calcium sulphate has been tried for the fixation of the ammonia, but has met with success only when pure gases were used, such as ammonia made by the Haber process. With dilute gases, equilibrium conditions do not permit the accumulation of sufficient ammonia and the vapor pressure of the ammonia in the washing solutions soon reaches that of the gas.

The use of metallic salts in solution has been suggested by several investigators. In his original process, Feld used a solution of iron sulphate, which was converted into ammonium sulphate and iron sulphide by circulation over the gases and the latter was regenerated by treatment with dilute sulphur dioxide while suspended in water. This oxidation was accomplished via the reactions thiosulphate and polythionate, which on heating decomposed to sulphate and sulphur, the latter product being reintroduced into the cycle of operations. The process failed owing to the inability of fully oxidizing the FeS, so that the introduction of fresh iron salt was necessary to sustain the cycle.

Instead of the wet oxidation of the heavy metal sulphide, as Feld's method may be termed, Fabry uses a roasting process, in which zinc sulphide is washed free from sulphate after its precipitation by circulation over the gases, and is then given an oxidizing roast to regenerate it to sulphate. One of the features of the successful operation of this process is the conversion of the sulphide without undue loss of sulphur. Cobb

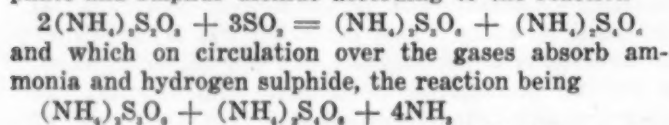
The tendency to rest on one's laurels, to feel that a good job has been done and that progress can be allowed to wait on inclination, is fortunately not apparent to any extent in American industry. However, from time to time this temptation does visit some branch of manufacture, and when it does, it is sometimes stimulating to look abroad, and from foreign activities to acquire a spur to renewed effort. We do not wish to suggest that the coke-oven industry has been oversatisfied with its methods of byproduct recovery. It is our hope, however, that articles such as this will prove to be the preventive that will eliminate any necessity for a future cure.—*The Editors.*

evidently does not contemplate complete oxidation, for after leaching the soluble sulphate obtained in the above manner, he suspends the insoluble metal precipitate in water for further treatment with dilute sulphur dioxide. The experience gained in metallurgical roasting operations in connection with the electrolytic recovery of zinc would undoubtedly be of assistance in helping to solve this phase of these and similar processes, the difficulties of which would probably diminish in inverse ratio to the scale of operations, for a continuous roasting process is more easily controlled than an intermittent one. The treatment of the insoluble residue with sulphuric acid might also be considered in preference to introducing fresh zinc sulphate for operating the cycle. With processes using these heavy metal salts, it is desirable to remove first the hydrocyanic acid from the gases, so as to avoid detrimental secondary reactions and contamination of the ammonium sulphate.

AMMONIUM SULPHITE PROCESS

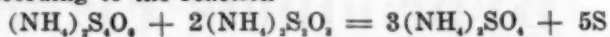
The Burkheiser process uses the established method of absorbing sulphuretted hydrogen by iron oxide, the sulphur of which is burned and absorbed in a solution of ammonium sulphite. As this becomes acid, it is circulated over the gases to absorb ammonia, the cycle being repeated until sufficient ammonium salts have been accumulated in solution. Due to the high vapor pressure of both the ammonia and the sulphur dioxide of bisulphite solutions, the process appears more suitable for the absorption of ammonia by distilling ammoniacal liquor. The bugbear of the process, however, has been the oxidation of the sulphite, as not more than 60 per cent of the sulphite has been oxidized to sulphate. Frietzsch sought to overcome this difficulty by using aluminum sulphite, which is obtained by treating aluminum hydroxide with sulphur dioxide. Oxidation to sulphate is said to proceed satisfactorily in the presence of ammonium sulphate, which accumulates in the solution after circulation of the aluminum salt over the gases. The ammonium sulphate is evaporated after the final precipitation of the hydroxide by the ammonia of the gases. This process, like the former one, requires separate plant units for the absorption of the sulphur, although Burkheiser claimed to have developed a very active iron oxide, which was capable of absorbing fresh hydrogen sulphide after burning its sulphur.

To overcome the disadvantages of handling the precipitates of the heavy metal sulphides, Feld developed his polythionate process, which contains only ammonium salts in solution. These polythionates are the products of reaction between ammonium thiosulphate and sulphur dioxide according to the reaction



Thus thiosulphate is regenerated in the washing system and the solution is rendered capable of further absorption by being brought into contact with sulphur dioxide gases, which are obtained by burning the sulphur produced by the process itself. Thiosulphate solutions are very efficient absorption mediums for sulphur dioxide, no matter how dilute, although at no stage of the process is it necessary to convert more than one-third of the thiosulphate into polythionate. As the

solution becomes enriched in ammonium salts, part is withdrawn and the above proportion of polythionate formed. On heating the solution, decomposition occurs according to the reaction



Thus the sulphur is liberated in two stages, although it is only separated prior to the evaporation of the solutions for the recovery of sulphate. The sulphur is fed to the burners for generating the dioxide for the support of the reactions.

The tendency of the solutions is to absorb more ammonia than hydrogen sulphide, but by increasing the washing area further sulphur to any desired extent may be absorbed, so that, in addition to ammonium sulphate, sulphur may be produced as a byproduct from the gases. It has also been suggested to use these reactions for the manufacture of sulphate by the indirect process, since the polythionate-thiosulphate solutions are equally capable of converting into sulphate the aqueous ammonia absorbed by scrubbing the gases with water. (E. V. Espenhahn, *J. Soc. Chem. Ind.*, May 15, 1917.)

This process may lay claim to having a good chance of solving the problem of the simultaneous recovery of ammonia and sulphur, not only from coke-oven but also from coal gases, in which category the author also places the processes of Fabry and Cobb, modified if necessary to use extraneous acid. The Feld process has perhaps progressed furthest experimentally, but it has suffered from the death of its inventor as it was entering upon its most interesting stage. Obtuse as the polythionate reactions may appear—Feld was the first to make commercial use of them—those involved in the process proceed simply enough and the many interesting questions of a theoretical nature do not concern the working of the process.

RECOVERING CYANIDES

In a previous paper the author (E. V. Espenhahn, *Chem. & Met.*, vol. 20, May 17, 1922) has pointed out that the hydrocyanic acid of coke-oven gases forms an appreciable although latent source of supply of cyanides and ferrocyanides. With none of the processes fully developed, it cannot be predicted to what extent they are capable of replacing the considerable tonnages now being imported or competing with the product manufactured synthetically in this country. It is necessary only to point out that the consumption of sodium cyanide is rapidly gaining and that the new uses found for this salt promise greater increases, an indication of which is the erection of new plants in California to supply the needs of the local fruit growers. As regards the imports, it is interesting to note that a more than 100 per cent increase occurred during the first 10 months of 1923 over a similar period of the previous year—namely, from 4,667 short tons to 9,562 tons. Thus the indications are that the hitherto yearly record consumption of about 12,000 tons in this country is now being exceeded. With an economical process of extracting the hydrocyanic acid from coal gas, such as is considered very probable, an appreciable percentage of this commodity could be cared for in this manner.

PRODUCING ALCOHOL

Considerable optimism was evinced by Bury and Ollander (*Gas World*, Coking Section, Feb. 7, 1920) and others in England as to the possibility of contributing toward the liquid fuel needs of the country the

alcohol derived from the ethylene of coke-oven gases. No further developments in this direction have been recorded, however. From experiments conducted by the author, he does not consider that the suggested method of absorbing the ethylene direct in sulphuric acid at higher temperatures will ever be successful. Besides poor absorption, as much as 0.4 per cent free oxygen in the gases causes decomposition and polymerization of the absorbed hydrocarbons so that sulphur dioxide is given off freely long before the saturation point is reached, and a resinous mass instead of alcohol is liberated on diluting the acid. The sulphonation of the ethylene may be accomplished satisfactorily, however, after it has been recovered in pure form, such as is accomplished by the fractional condensation of the constituents of coke-oven gases by the Claude process, using refrigeration.

TAR AND NAPHTHALENE

The fractional condensation of tar has been proposed by Feld and it is believed that installations have been successfully operated in Germany. It seems quite a logical procedure to obtain the tar fractions before condensing instead of fractionating in stills afterward. To this end the gases are maintained at a constant temperature for a given interval while they are scrubbed with the liquid tar fraction to be condensed. In this manner 70 per cent of the pitch was recovered in the first operation by scrubbing at 180 deg. C., and by cooling to 120 deg. C. the rest of the pitch and some light oils were condensed in a second step, giving a Stahlwerksteer—that is, a light pitch—which may be used for painting iron work, etc. The lightest fractions were obtained after further cooling and scrubbing at atmospheric temperature and yielded an oil suitable for Diesel engines. The principle appears flexible, so that the process should be capable of condensing fractions to meet the demands of local conditions.

A minor consideration is the recovery of the naphthalene, which is entrained in the washwater from the final cooling of the gas and now runs to waste, although in the aggregate the quantity thus lost is undoubtedly considerable. It is suggested this may be recovered by adding a preferential solvent, such as debenzolizing oil, to the water before it is circulated over the coolers. After its separation from the effluent and the absorption of sufficient naphthalene, it is added to the larger bulk of the wash oil or distilled separately to recover the above product.

Other uses have been suggested for constituents of coke-oven gases, such as using the hydrogen for the manufacture of synthetic ammonia and the gas itself for the recovery of nitric acid by the Haeuser process. These processes, however, are closely related to nitrogen fixation problems and must be considered in conjunction with them. The possibilities in this direction are ably discussed in the report of the nitrogen products committee of the British Munitions Inventions Committee, as well as the methods of using coke-oven gases for the generation of power.

The above problems have been reviewed, as it is believed that there are coke-oven operators that are interested in the more extensive recovery of their byproducts, if it is at all economical for them to do so. It must be admitted, however, that any departures in this direction will be attended by increased cost of plant construction. But if the processes are successful they will amply reward any labor extended in their investi-

gation and exploitation. A factor that has operated against departures from standard practice, especially in Europe, has been the fact that they require more skilled control. This objection is not so likely to be encountered in this country, for J. Becker (*Chem. & Met.*, 1922, vol. 27, p. 875) has attributed the admirable results obtained in the operation of byproduct coke ovens in America to a great extent to the employment of superior supervision. There is no reason why this skill should not be applied to an attempt more fully to utilize byproducts that are now going to waste.

Legal Notes

Gans Patent for Water-Softening Apparatus Declared Invalid

First Adverse Decision in the Series of Suits Brought by the Permutit Co. in Defense of This So-Called Basic Patent

A significant decision in the series of suits instituted by the Permutit Co. in the endeavor to have sustained what it has claimed to be the basic character of the Gans patent, U. S. No. 1,195,923, was handed down Nov. 8, 1923, in the United States District Court, at Detroit, Mich. In a decision, supported by a very exhaustive opinion, Judge Tuttle has ruled that "the patent in suit is utterly lacking in invention and is absolutely void."

To appreciate the importance of this decision and its effect on the future manufacture and sale of zeolite or base exchange water-softening equipment—a business which amounts to several million dollars annually—it is necessary to review briefly the patent in question and the litigation concerning it.

As pointed out by Judge Tuttle, the Gans patent in suit is purely an apparatus patent. It does not purport to cover either the zeolites themselves or the process of using them to soften water. The utility of zeolites for water softening was known and described many years before the Gans patent was applied for. Throughout the course of the Permutit litigation—and there have been two suits other than that brought at Detroit—the company has contended that the apparatus disclosed by the Gans patent was the first to soften water successfully by means of zeolites, and that Gans by this invention had established the industry. The several defendants have contended that there is no novelty or invention in the Gans apparatus; that a zeolite water softener is essentially a water-softening filter; that there is no invention involved in merely substituting a zeolite layer in place of the customary sand layer in a sand filter, in passing water downwardly through it to be purified, or in providing the necessary piping and valves to permit passing a salt solution through the zeolite layer to regenerate it. In short, they hold that Gans, in providing suitable apparatus for utilizing his zeolites, simply drew on the existing filter art, to which he himself refers in the patent; and lastly, aside from any question of invention, that prior published descriptions of zeolite water-softening apparatus show the same elements employed in the same relation to produce the same result, and consequently anticipate and invalidate the claims of the patent in suit.

The essential features of the apparatus described in

the Gans patent are exemplified in claims 1 and 5, the only ones which have been asserted by the Permutit Co.

Claim 1 was drawn to cover any water-softening apparatus having a casing containing a layer of zeolites supported on a bed of sand or quartz, and provided with means for passing water through the apparatus, for cutting off the supply of water when the zeolites are exhausted, and for regenerating the zeolites by passing a salt solution through the zeolites.

Claim 5 covers essentially the same ground as claim 1, with the additional stipulation that means is provided at the lowest point of the casing for removing the salt solution used for regeneration.

EARLIER LITIGATION

The first case reached for trial was decided in favor of the Permutit Co. in June, 1921. This was the case of the Permutit Co. vs. Harvey Laundry Co., a user, and the Refinite Co., the manufacturer of the softener complained of. It was brought in the U. S. District Court of the Western District of New York and Judge Hazel held that this apparatus was an infringement and that claims 1 and 5 of the Gans patent were valid. Judge Hazel's decision was affirmed in February, 1922, by the U. S. Circuit Court of Appeals for the Second Circuit.

During the progress of the Refinite case, it was shown that 4 years prior to Gans' application, Dr. Feldhoff, chemist of the German Riedel organization, the original owner of the Gans patent, had published an article describing a zeolite softener having all the elements claimed in the Gans patent. The only difference was that Feldhoff used an upward flow for both the hard water and the regenerating brine. When this publication came to light, the Permutit Co. filed a disclaimer as to the scope of claim 1, disclaiming "any water-softening apparatus . . . in which the water to be softened is so introduced into the casing that it passes upwardly through said layer of zeolites."

As a result of this disclaimer, manufacturers were free to make zeolite-softening apparatus in which the water being softened, and the regenerating brine, were passed upward through the zeolites and withdrawn from the upper portion of the casing.

In July, 1923, the Permutit Co. was granted a temporary injunction in the Southern District of New York restraining the Paige & Jones Chemical Co. from selling zeolite water softeners using downward filtration. In this case the Leister German patent No. 211,064 was cited as an additional defense. It shows a zeolite softener in which the water to be softened is passed downward and the brine upward, and it was published more than 2 years prior to the time Gans applied for his patent.

The Permutit Co. contended, and Judge Hand held, that the Leister patent was not sufficient to invalidate the Gans patent, upon the assumption that undesignated solid lines at the upper and lower boundaries of the zeolite layer, shown in the drawings, indicated perforated plates which locked the zeolite bed and prevented its expansion during backwashing. Upon this assumption the conclusion was reached that the Leister apparatus was inoperative, that it did not contribute anything to the art, and therefore did not anticipate the Gans patent.

This, then, was the status of the litigation when the suit at Detroit against the Massachusetts Laundry

Co. and the Borromite Co. of America came to trial. The latter organization had been acquired by the Wayne Tank & Pump Co. some time after the suit had been filed, and the Wayne company therefore was one of the real parties at interest. In the apparatus complained of in the Detroit suit, the water being softened was passed downward and the brine upward through the zeolite bed. This was the operation disclosed by the Leister patent.

The trial was replete with interesting features. Most of the testimony in open court was in German, for the Permutit Co. brought over for the occasion Dr. Paul Siedler, technical director, and Dr. Cornelius Massatch, a chemist, of the Riedel Aktiengesellschaft, which was the parent organization of the Permutit company. The Wayne company brought over August Neumann, an engineer and builder of filter plants, later engaged by the Riedel Aktiengesellschaft and the German Permutit Filter Co. to design and install zeolite apparatus. Neumann brought with him several of the small domestic softeners he had built, sold and advertised, and for which he had taken out German Gebrauchsmuster patents several years before the Gans patent was applied for. Small models and wall charts showed graphically the construction and operation of the various types of prior art apparatus.

The trial consumed 9 days. Much new testimony was introduced that had not been before the New York courts in the prior suits. More than three hundred exhibits were entered in the record. Judge Tuttle, in view of the prior decisions involving the patent in suit, carried out fully his expressed intention of giving both sides the fullest opportunity of presenting everything that might have had a bearing on the case. He took an active part in the examination of the witnesses and showed a remarkable grasp of the technical considerations involved; and in his opinion, delivered from the bench immediately after the counsel had closed their arguments, he discussed the process of zeolite water softening with a thoroughness and understanding that would have reflected credit on one actively engaged in the water-softening industry.

It is understood, however, that the Permutit Co. has appealed from the decree entered by Judge Tuttle.

Utilizing Waste Slag From Blast Furnaces

Research in Germany on the production of an artificial pumice from slag has resulted in interesting developments in the efficient utilization of this by-product, especially for the manufacture of heat-insulating brick. An article in *Stahl und Eisen* shows that 3 per cent of ferrous oxide must be recognized as a maximum if a satisfactory product is expected. Porosity is dependent largely on the presence of moisture during blowing, the froths made under such conditions containing an infinite number of sealed air pockets.

Bricks have been made from this slag froth, and satisfactory service is claimed, adequate annealing and storage being essential before use. The froth is first passed between water-cooled rolls, and then molded to shape. The result is an insulating medium of high relative efficiency, possessing the additional advantage of impermeability. Such a product should find wide application; and cheapness of production may be expected as soon as methods of manufacture are standardized.

Using the Mixture Method in Measuring Flow of Gases

Results of an Application of This Method, Suggested by the Salt Solution Method for Measuring the Flow of Water, Show That It Is of Value in Related Problems of Fluid Flow

By Charles P. Turner and B. W. Winship

Chief Engineer and Superintendent of Coke Ovens, respectively,
Bethlehem Steel Co., Steelton Plant

THE convenience and accuracy of the salt solution method for measuring flow of water, and its adaptability to wide ranges of quantity under conditions where it is practically impossible to get satisfactory results by other known methods, suggested the idea of applying the same general principles to the measurement of the flow of gases.

A practical application of this method is the subject of this paper. A number of blast furnace blowing engines at our plant, all having 84x60-in. blowing tubs, are equipped with two quite different types of automatic inlet and discharge valves. The furnaces served by the engines having one type of valve called for a higher speed to produce a given tonnage than was needed when the other engines were used. This difference was so marked and so well maintained over a long period of service that a definite measure of the relative discharge efficiencies of the two types under actual operating conditions became highly desirable as a check on the results indicated by furnace fuel consumption and iron produced.

Some tests were run in which an attempt was made to measure the air output by the flow through a standard nozzle, following closely the method prescribed by the code recently published by the A.S.M.E. committee on displacement compressors and blowers. However, the large volumes of air involved forecast large expense in applying a correctly formed nozzle in a proper location in the blast mains to make necessary measurements without interfering with the blast supply and with normal operating conditions. It was at this point that the mixture method was suggested and, since it could be carried out at comparatively small expense and applied to the engines without interfering in any way with their regular service, a set of tests with the two types of valves was carried out.

The plant operates a set of coke ovens with byproduct recovery, and a laboratory with trained chemists and complete equipment for making accurate ammonia determinations. These circumstances led to the adoption of ammonia gas, which has the following advantages for the purpose: It is readily procurable in a liquid form in large-sized drums,

vaporizes readily, mixes rapidly and evenly with air, the smallest possible losses through leaky connections are immediately discernible by its odor and it is readily absorbed from the air with a formation of a stable compound when a mixture is passed through a solution of H_2SO_4 .

A drawing (Fig. 1) herewith shows the arrangement of apparatus used as applied to one of the blowing engines. Photographs of the apparatus as set up also accompany this paper. A drum A containing about 150 lb. of anhydrous ammonia rests on the platform of a scale the beam B of which is graduated to read to 0.01 lb. A flexible connection *t* leads the ammonia from A through a standard ammonia needle controlling valve D, a coil in a steam-heated chamber E, which insures its complete vaporization, and the pipe F into the discharge header G over the blowing tub H. The air and ammonia from the header G in passing through the valve J and connecting pipe K to the receiver L become so thoroughly mixed that a sample drawn from the receiver at M carries them in the proportion in which they are introduced.

The pressure of the air in the receiver L may vary during regular blast-furnace operation from a low of 12 or 15 lb. per square inch to a high of nearly 30 lb., and there are rather violent pulsations due to the large relative size of the air tub H. However, the average pressure during the period involved in any single test run is fairly uniform. The question of taking out a sample at a uniform rate under a workable pres-

FLUID FLOW

In *Chem. & Met.* for Jan. 14, 1924, there appeared an article by Eric Crewdson on the determination of the velocity of fluid flow by the salt method, as applied to the flow of water in pipes. At that time it was suggested that this method should be suggestive of the procedure to be followed in other cases, where salt solution could not perhaps be used, but the principle involved could be employed. Herewith is presented an account of an experiment in which this was done, an exactly analogous method being developed wherein ammonia gas and air replace sodium chloride and water.

A UNIT PROCESS OF CHEMICAL ENGINEERING

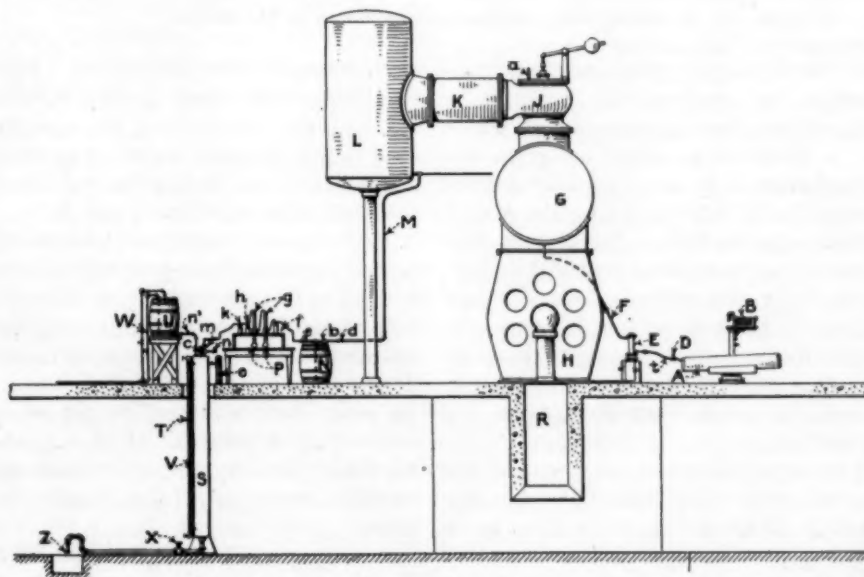


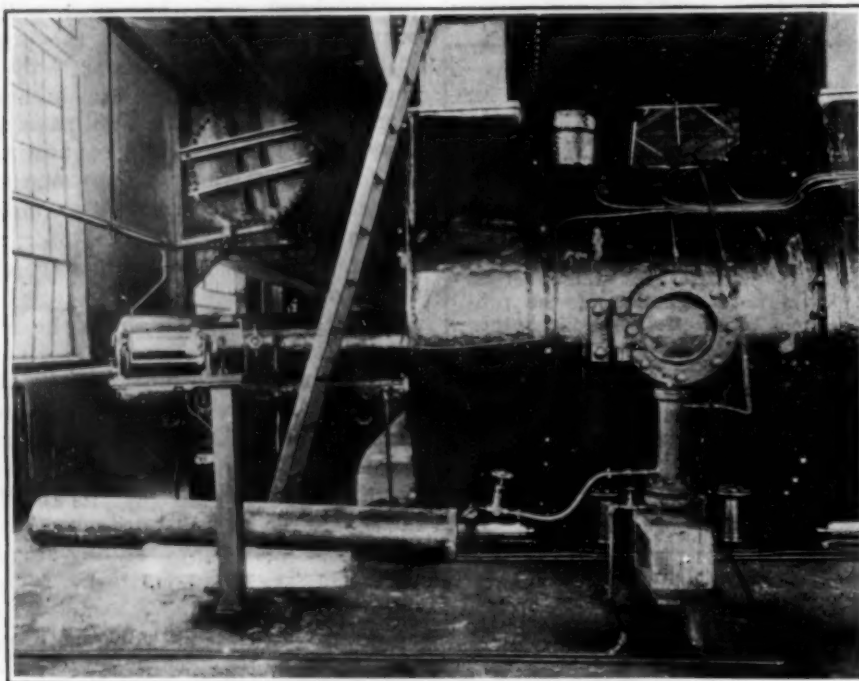
Fig. 1—Layout of Equipment for Measuring Gas Flow

sure therefore depends largely on providing a practicable method of smoothing out the pulsations and reducing the average pressure to the desired amount. For this purpose the air was led through a throttling valve *d* to a bleeder pipe with its open end submerged about 20 in. in water in the barrel *N*. The effect of this combination was to secure a supply of air in the pipe *e* leading to the absorption towers *gg* at a practically uniform pressure fixed by the depth of submergence of the open end of the bleeder pipe.

The aspirator for inducing the flow of air from *e* through the absorption towers consisted of the standpipe *S* made of a section of standard 12-in. wrought pipe with welded heads and connections. The volume

than 1 lb. per minute during a 10-minute run. The air to the intake valves was led through openings in the bottoms of the air tub heads from a passage *R* in the foundation that connected with the outside air through a window in the engine room basement in such a way as to draw most of the air to the cylinder from outside of the engine room. An observer was stationed near the inlet to take readings of temperature and of humidity as shown by a Lloyd's hygrodeik.

The standpipe *S* was filled with water at room temperature until it overflowed at the valve *n*; the supply was then shut off at *n'*. Valve *d* was opened until air from the receiver *L* flowed through the absorption towers *gg*, each of which had



Ammonia Tank, Heater and Connection to Air Header

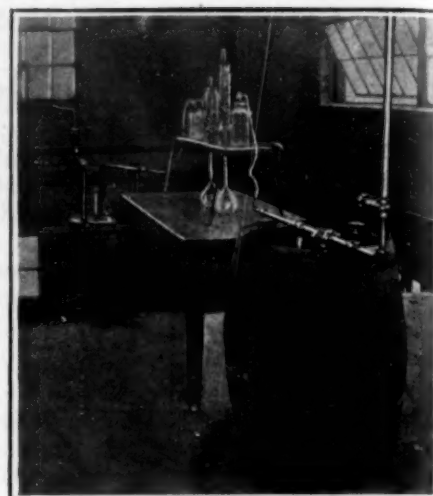
of this standpipe was carefully calibrated by noting the heights to which weighed increments of water at a fixed temperature stood in the gage glass *T* as measured by a fixed scale *V*. Water for filling the standpipe in preparation for a test was heated to room temperature in barrels *U* by the introduction of steam through the connection *W*, and considerable care was taken to keep all of this part of the equipment at as near the room temperature as was possible.

In running a test one man at the scales controlled the flow of ammonia through the valve *D* so as to draw from the tank *A*, as indicated by the scale beam *B*, at a practically uniform rate, generally a little less

than 1 lb. per minute during a 10-minute run. The air to the intake valves was led through openings in the bottoms of the air tub heads from a passage *R* in the foundation that connected with the outside air through a window in the engine room basement in such a way as to draw most of the air to the cylinder from outside of the engine room. An observer was stationed near the inlet to take readings of temperature and of humidity as shown by a Lloyd's hygrodeik.

The standpipe *S* was filled with water at room temperature until it overflowed at the valve *n*; the supply was then shut off at *n'*. Valve *d* was opened until air from the receiver *L* flowed through the absorption towers *gg*, each of which had

been charged with 250 c.c. of water, and their connections to the valve *n* and into the atmosphere, the opening of *d* being adjusted so as to produce a moderate but steady flow through the pipe submerged in barrel *N*.



Sampling Barrel and Absorption Towers

cylinder *A* had been adjusted to a practically uniform predetermined rate, a signal was given, at which instant the three-way cock *b* was closed so as to force air from *L* through *N* and the valves *X* and *m* were simultaneously opened so as to permit the water from *S* to flow out through the nozzle *Z* and draw air from *e* through absorption towers *gg*. The nozzle *Z* was adjusted so as nearly to empty *S* in the 10-minute period of a test run.

At 5-minute intervals signals were given, at which records were made of the weight of ammonia in *A*; the temperature and humidity instrument readings for the intake air at *R*; temperature shown by a thermometer in the ammonia vaporizing chamber *E*; temperature shown by the thermometer *a* of the discharge air from the tub; the gage pressure of the air in the discharge pipe; the number of revolutions of the engine as shown by a revolution counter; the temperature, as shown by a thermometer *c*, of the air in *S*; the pressure of the air in *S* as shown by a manometer *o*; and the volume of air in *S* as shown by readings on the scale *V*.

At the end of the test, valves *X*, *m* and *b* were closed and the volume, pressure and temperature of the air in *S* were noted with especial care, as these values are essential to the correct working out of the results.

In the train of flasks comprising the absorption system *f* is for catching any spray that may be carried by the air before it enters the solution of H_2SO_4 in the absorption towers *gg*, *h* is a similar eliminator for any spray that may be carried over from the absorption towers and *k* contains methyl orange as a test

Gas Blowing Engine A

Summary of Results of Discharge Efficiency Tests of Air Tub Made by Ammonia Vapor Moisture Process. Tests Conducted February and March, 1922.

Blast Pressure, Lb.	Speed of Engine, R.p.m.	Theoretical Displacement at Observed Speed, Cu.Ft. Per Min.	Actual Displacement at Observed Speed, Cu.Ft. Per Min.	Blowing Tub Efficiency, Per Cent
19	59.2	21,957	20,756	94.5
19½	59.9	22,216	21,007	94.5
21	60.9	22,588	21,200	93.88
22	60.0	22,254	20,850	93.70
23	60.7	22,514	21,056	93.50

to show whether any ammonia has passed through the solution with the air. After one or two preliminary runs it was found that the rate of flow through the apparatus as constructed was so slow that nothing was deposited in either of the flasks *f* or *h* and no discoloration of the solution in *k* showed during either of the tests. Flasks *P* were used to receive the H_2SO_4 from towers *gg*, and the volume of the sample was made up to 1 liter in each flask by the addition of distilled water.

Vaporization of Ammonia—In the first preliminary tests dependence was placed on heat from the atmosphere for vaporizing the ammonia; but it was found that the transfer of heat through the tank and connections was too slow to prevent some of the liquid from entering the air passages and failing to mix uniformly with the air; a steam-heated vaporizer *E* was therefore inserted in the ammonia pipe. When this vaporizer was located lower than the outlet opening in the end of the drum, enough vaporization took place in the tube between the drum and the vaporizer as the liquid flowed down through it to cause considerable trouble. This was overcome by raising the vaporizer high enough to keep the pipe leading to it from the drum filled with liquid and so confine the vaporization almost entirely to the steam-heated chamber.

The averages or totals shown by the log of a typical test run are:

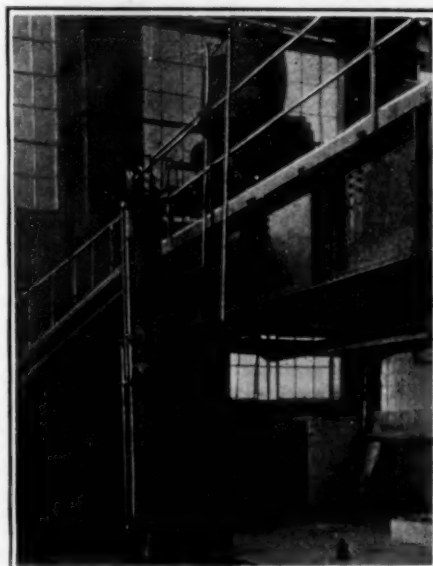
Duration of test, min.	10
Blast pressure by gage, lb. per sq. in.	19
Speed of engine, r.p.m.	66.6
Temp. of air, thermometer <i>a</i> , deg. C.	112.22
Temp. of air, in aspirator <i>S</i> , deg. C.	22.22
Temp. of air, to engine, deg. C.	17.78
Temp. of outside atmosphere, deg. C.	11.11
Temp. of water to aspirator <i>S</i> , deg. C.	22.22
Temp. of vaporizing chamber <i>E</i> , deg. C.	117.77
Temp. of dry bulb thermometer, deg. C.	17.78
Temp. of wet bulb thermometer, deg. C.	12.22
Barometer pressure, mm. Hg.	760.73
Manometer pressure in aspirator, mm. H_2O	288.925
Corresponding barometer pressure in aspirator, mm. Hg.	739.48
Ammonia to engine, kg.	2.9937
Air in aspirator at temperature of 22.22 deg. C. and 739.48 mm. Hg. pressure, cu. m.	0.2435
Piston displacement, cu. m. per min.	702.65

Air Discharged During Test—We can assume that the air in the aspirator *S* is saturated at the observed temperature and pressure.

From psychrometric tables the tension of water vapor at 22.22 deg. C. is found to be 19.93675 mm. Hg. Substituting this and the observed values for temperature and pressure in the formula for weight of mixtures of gases and vapors, the weight of the air in the aspirator is

$$G = \frac{1.2932 (739.48 - 0.377 \times 19.93675)}{(1 + 0.003665 \times 22.22) 760} \times 0.2435 = 0.28044 \text{ kg.}$$

Further, the water content of 1 cu. m. of saturated air at 22.22 deg. C. is found to be 0.019542 kg., from



Water Heating Barrels and Aspirator

which the weight of water vapor in *S* is $0.019542 \times 0.2435 = 0.00476$ kg., from which the weight of dry air in *S* is $0.28044 - 0.00476 = 0.27568$ kg.

From the chemical analysis, the ammonia absorbed from this air was found to be 0.1146887 grams. Since the total ammonia fed to the air from the engine was 2.9937 kg. we find by proportion that the weight of dry air discharged during the test was

$$\frac{0.27568 \times 2.9937 \times 1000}{0.1146887} = 7196.03 \text{ kg.}$$

Air Corresponding to Piston Displacement—From psychrometric tables the tension of the vapor in the air to the engine is found to be 7.874 mm. Hg. from which the tension of the air with moisture removed is $760.73 - 7.874 = 752.856$ mm. Hg. The tables also show the weight of dry air at a tension of 760 mm. and a temperature of 17.78 deg. C. to be 1.214 kg. per cu. m., or

$$\frac{1.214 \times 752.856}{760} = 1.2026 \text{ kg. per cu. m. at a tension of 752.856 mm. and temperature of 17.78 deg. C.}$$

The weight of dry air corresponding to the piston displacement volume during the test is, therefore, $1.2026 \times 702.65 \times 10 = 8450.07$ kg. and the discharge efficiency $7196.03 \div 8450.07 = 0.8516 = 85.16$ per cent.

Italian Potash Industry Grows

The Italian potash industry grew out of the war. Germany's virtual monopoly before 1914 obliged allied and neutral nations to become dependent on that country. During the war and up to 1919 all countries were obliged to make what use of other facilities and sources that might suggest themselves and this regardless of the production cost of the commodity. It was at this time that Italy first considered the possibility of exploiting her lava deposits for the extraction of potash.

The Italian industry at present seems in a fair way to expand sufficiently to cater to the entire needs of the country. Conditions of exploitation and distribution are particularly favorable. By finding in her deposits of leucite (composed of silicate of alumina and potash) lava that contains as high as 21 per cent of pure potash salts Italy has been fortunate, since ordinary lava does not give a return of more than 3 per cent.

The ground leucite of Italy is said to be superior as a composite fertilizer to that of Germany, due to its slower solubility. Production costs are not higher than those of the Thuringian mines, which, together with the Alsatian mines of the French, were the previous source of the Italian agriculturist's supply. Both these well-known enterprises are bound to suffer in seasons to come by the increasing development of Italy's own supply; indeed the Italians themselves optimistically believe that they have an export market awaiting them.

The treatment of lava potash and its transformation into fertilizer is actually in the hands of the Societa Italiana Potassa, which has a contract with many Italian groups of agriculturists to supply their needs.

It is not only for agricultural needs that these deposits are being developed. A company with a capital of 4,500,000 lire is constructing a plant at Civita Castellana, to the north of Rome, for the manufacture of potassium nitrate. With this as a base, certain far-seeing Italians predict a formidable growth for this new Italian chemical industry.

Equipment News

From Maker and User

Heavy Duty Elevating Truck

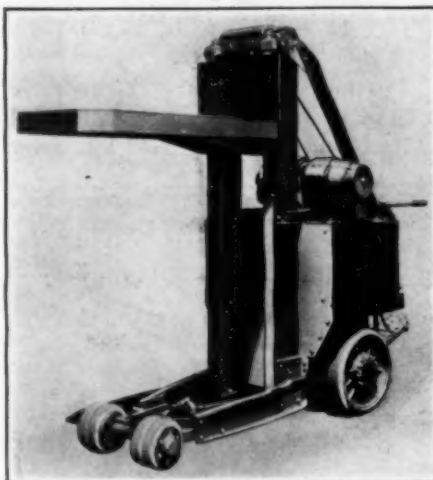
**Storage Battery Lift and Tying Truck
Will Handle 3 Tons at a
Height of 6 Feet**

One of the latest developments in the electric industrial truck field is the new "Hi Lo Tructor," a high-lift storage battery truck recently brought out by the Elwell-Parker Electric Co., Cleveland, Ohio. This machine is built to pick up, transfer and set down skids loaded up to 6,000 lb., at any place over a vertical range of 72 in. This permits the handling or stacking of much greater loads than former designs of tying trucks, which would operate only up to 4,000 lb.

The machine is 112 in. long, 95 in. high and may be driven through a 3 ft. 6 in. doorway.

By virtue of the function of this truck, the elevator platform is designed to receive loads near the floor, resulting in there being little room for mechanism beneath. The load deck therefore is a cantilever, built of heavy formed plates on long, large section steel arms. Each of the two arms at the supported ends carries two large rollers fitted with double row ball bearings. The lower or forward rollers just beneath that platform are provided with deep flanges and travel on machined ways on the face of very heavy channel uprights. The upper rollers are straight faced and bear on a machined way on the rear side of channel. The two platform arms also carry the moving portion of the hoist mechanism, which counterbalances a portion of the platform weight. The hoisting or elevating of the load deck is accomplished by means of an Elwell-Parker fully inclosed motor connected to a double-grooved hoist drum, forming an efficient self-contained unit located just over battery compartment.

Two single straight running plow cables run over two sheaves at the top of the elevator uprights, thence to two grooved drums carried on the elevator head parallel to the main hoist drum. These cables drive the drums, which in turn drive two heavy pinions, one on either end of the drum support shaft. When the two single cables are wound in on the main drum by motor, the secondary drums revolve and the pinions travel up the heavy racks on elevator columns, carrying the elevator head and platform with them. Each of the two cables carries less than 25 per cent of the load. Any stretching of cables is automatically compensated. These two pinions, with the forward flanged rollers, assure a level platform, regardless of load distribution. The long centers between the two pair of rollers and heavy arms assure a level



Heavy Duty Tying Truck

platform, regardless of load distribution along its surface.

A safety or trip switch automatically limits travel and opens in case the outer end of the platform when descending catches on an obstruction. When the loaded platform descends, it drives the hoist motor as a generator and returns some of the power drawn from the battery when raising. Heavy steel castings with wide flanges, particularly inside, join the two axles. The elevator ways or uprights are riveted into these steel sills as well as to the structural frame above the drive axle.

The three point supported unit power plant consists of a heavier inclosed Elwell-Parker motor direct connected to worm gear or heavy bevel differential. The worm, worm wheel and differential are all assembled and adjusted as a unit at the bench, then dropped into the differential case and firmly locked by four large cap screws.

A service brake drum with flexible joint inside is located between the motor and the differential. Heavy alloy drive shafts spline into the differential. Each drive shaft is fitted with a chrome vanadium ball universal joint to permit steering simultaneously with driving. This joint is located beneath the knuckle pin. The knuckle pin carries a 1-in. ball at top, providing easy turning. The knuckle with hub is made from a single drop forging. The hub is fitted with a 7-in. double row radial and thrust bearing with 12-in. balls. Each drive shaft carries a heavy forged clutch plate bolted to the outside of the drive wheel. The drive wheels are fitted with 22x44-in. solid rubber tires. Each yoke between differential case and knuckle is machined with saddles for dual coil springs, which carry the frame at this point. These springs are packed with oil-saturated waste and a canal in a yoke spring socket leads the oil to

a felt pad, which contacts with a renewable liner bolted to the frame axle guide.

The front axle is novel in design, consisting of a heavy steel casting bored and fitted with a heavy steel axle, which carries on knuckle pins two cupped wheels with two sets of long tapered roller bearings in dust-proof case and dual 10x3 solid rubber tires. These tires are not pressed on, but are fitted to the wheel and will differentiate when wheel is steered. This provides the easy steering so necessary, for the major portion of the load is carried on this axle. The wide spread of tire contact surface distributes this load as a single one of same width, but permits at the same time steering on this heavy tool where the wide single tire could not.

No levers between axles drop below the main frame. No levers extend beyond the front axle, and when the platform is elevated the tires on these wheels serve as rubber bumpers, cushioning the shock to the tractor and causing no damage to the obstruction. The platform has patented tapered nose and is in plain view when in the lowest position. All moving parts are inclosed. All electric wiring on dash is inclosed.

The control is standard E.P. automatic—that is, the operator cannot move the truck except when standing on the pedals at the rear. The main switch can be closed and power applied with the brake on, so necessary and safe for ramp operation. The switch closes only when the controller drum is in off position. If the operator steps off the truck, all electrical circuits are open and the brake is applied. The hoist controller handle and drive motor controller (when released) return to off position.

The battery compartment will accommodate thirty cell Edison or sixteen cell lead. Truck with battery weighs 5,200 lb. and travels at 300 to 400 ft. per minute and hoists at the speed of 5 to 6 ft. per minute.

Low Clearance Flow Motor

For the application of paints, varnishes, enamels and other liquid coatings, a new device has recently been placed on the market by C. M. S., Inc., Tarrytown, N. Y. This device is designed to make the coating by flowing rather than by spraying, its makers claiming that this is the best and most economical manner of applying a coating by machine, there being no loss in the atmosphere, as when a spray is used.

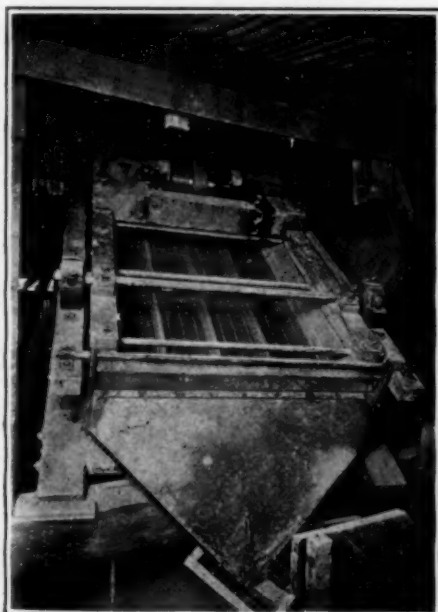
The device in question consists of a tank to contain the coating liquid, an impeller pump, and an electric motor. The length of this unit is 40 in. and the width is 23 in., the height from the floor, over all, being 14½ in. The weight

of the equipment is 201 lb. when the tank is empty. The motor is a $\frac{1}{2}$ -hp., 110-volt, single-phase, sixty-cycle, 1140-r.p.m. standard motor, and the pump is of the direct-connected, impeller type. The capacity of the tank is 11 gal. This unit is provided with an extra heavy metal-lined hose 15 ft. in length. Nozzles of two capacities can be supplied, that used with enamel or paint having a capacity of 5 gal. per minute, and that used with varnish having a capacity of 24 gal. per minute. These nozzles are supplied with screens so as to strain any foreign matter from the coating material before application.

Vibrating Screen of Novel Type

A vibrating screen operating on a new principle has recently been placed on the market by the Link-Belt Co. of Philadelphia, Pa. This screen, the invention of Prof. G. A. Overstrom, a mining engineer and formerly dean of the Utah College of Mining, is designed for the thorough screening of fine materials.

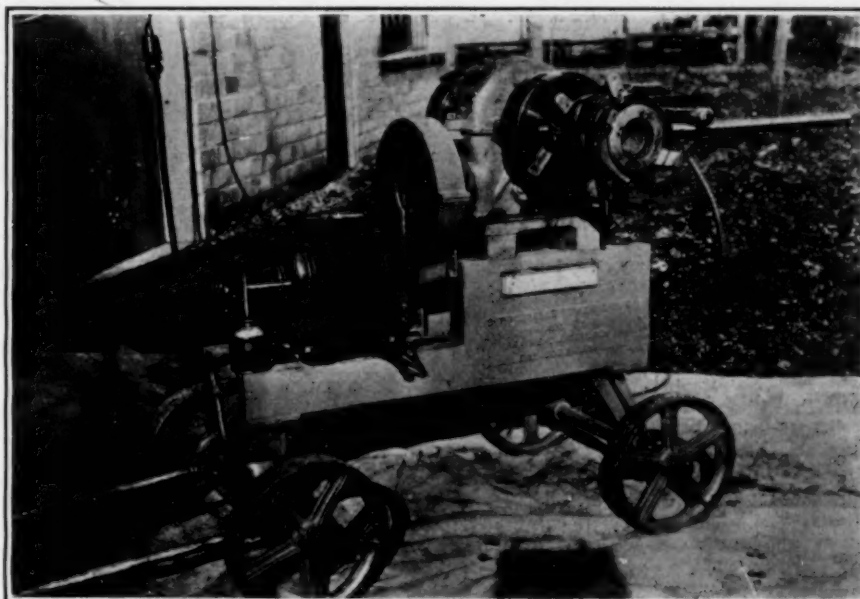
In place of the agitation obtained on vibrating screens now on the market—a series of rigidly imparted blows from



Novel Vibrating Screen

some mechanical or electrical device—the vibrations of the Link-Belt screen are produced by the action of an unbalanced pulley supported on the screening frame and rotated at high speed. It is claimed that this results in vibrating every portion of the screen uniformly, thereby making its entire surface available for effective work.

The screen is recommended by its makers for use in screening chemical products, coke, gypsum, cement, fertilizers, pigments, coal and other similar materials. In such service it is claimed to give thorough screening through the finest mesh of any product that can be screened. Advantages claimed for it are: simplest vibrator mechanism, no dead areas of screen cloth, degree of vibration easily adjusted, automatic



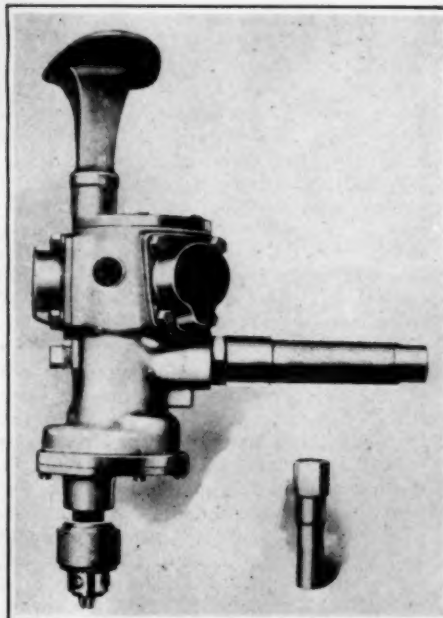
Portable Drive for Pipe Threading

and positive lubrication, and minimum upkeep and maintenance.

Lightweight Air Drill

To meet the demand for a lightweight air drill in the maintenance department of the industrial plant, the Ingersoll-Rand Co., 11 Broadway, New York City, has recently placed on the market its new size "D" pneumatic drill.

This drill is designed for light drilling up to $\frac{1}{8}$ in. diameter holes, and reaming up to $\frac{1}{4}$ -in. diameter. It may be fitted with breast plate, feed screw or grip handle and so is adapted to a wide variety of work. Among the features of this design are a lightweight aluminum case, with steel bushings cast in all the bearing holes and the throttle hole, cast-iron cylinders that are renewable and interchangeable and three-cylinder motor with replaceable parts. The speed is 700 r.p.m.; weight is 14 lb.; overall length is 15 in. and hose size $\frac{1}{2}$ in.



Lightweight Air Drill

Portable Power Drive

Those engaged in plant maintenance work know how often it is helpful to have a means of obtaining power at some remote and inconvenient part of the works. A machine that will undoubtedly be of interest in such cases is the new B. T. portable power drive manufactured by Brainerd & Toulson, Endicott, N. Y. This machine, shown in the accompanying cut, is particularly designed for the purpose of cutting off bolts and pipe, threading bolts and pipe and similar work where a rotating motion is necessary. It is supplied in two sizes, types A and B, and will handle bolts from $\frac{1}{2}$ to 1 in. and pipe from $\frac{1}{2}$ to 12 in.

The machine consists of an electric motor which drives through a reducing gear to a headstock. This headstock holds and rotates the work which it is desired to rotate by means of jaw chucks. In this way the work turns and the tool may be held still, thus permitting the use of any make of hand dies that may be on the plant.

Manufacturers' Latest Publications

Steere Engineering Co., Detroit, Mich.—Pamphlet 231. A new leaflet on purifier trays for gas plants.

Fiber Stone & Tile Works, Inc., Sewaren, N. J.—No. 23, Series D. A folder on the subject of fireproof building materials.

C. M. S., Inc., Tarrytown, N. Y.—Bulletin 101. A bulletin describing the C. M. S. low clearance type "Flomotor," used for applying such coatings as paint, varnish and enamel.

American Blower Co., Detroit, Mich.—Two folders, one on general ventilation for factories and offices, the other on a portable unit for room ventilation.

Philadelphia Gear Works, Philadelphia, Pa.—A pamphlet on various types of speed-reducing units such as spur gear, worm gear and helical gear.

Curtis Bay Copper & Iron Works, Baltimore, Md.—Bulletin 1. A folder on "Everbrite" forged stop-valves, which are valves made of a strong, non-corrosive alloy metal.

Williams Tool Corporation, Erie, Pa.—A catalog and a folder describing a new portable, power-driven pipe-threading tool, to fill an intermediate place between the hand-threading tool and the large power machine.

Readers' Views and Comments

An Open Forum for Subscribers

The editors invite discussion of articles and editorials or other topics of interest

Quality of Industrial Gas

To the Editor of Chem. & Met.:

SIR—On page 420 of the March 17, 1924, issue of *Chem. & Met.* appears an editorial entitled "Determining the Quality of Industrial Gas." Of course I do not know just where the editor obtained his information, but to one more or less acquainted with the activities of the gas industry, this editorial appears to cast a very unfair reflection upon the progressive work of the gas industry. Because I do not happen to know on just what basis you obtained your information, I cannot discuss the subject completely. However, there are a few salient features that I feel are worth bringing out.

In the first place, the B.t.u. value of a gas does not denote quality. The B.t.u. value of a combustible gas denotes quantity of heat and not quality. The quality of the heat contained in any gas is dependent upon the characteristics of combustion of that gas. Briefly, the more important characteristics of combustion are flame temperature, concentration of the heat unit in the products of combustion, and the flame propagation of the air-gas mixture.

The more progressive gas companies are making an endeavor to remove the antiquated heat standards for gas, because in many localities it has been found that a lower B.t.u. gas can be manufactured at lower cost per million B.t.u. than the usual 550 to 600 B.t.u. gas. This is true because a company in manufacturing lower B.t.u. gas does not have to go to distant fields to obtain high-grade coals, and it does not have to use such large quantities of oil for carburetion of the water gas.

Generally speaking, the economics of the situation indicate that our gas companies in very many localities can give the customer better service at a lower cost where more economical methods of gas manufacture can be used. In many cases this means lower B.t.u. gas.

It is not the purpose of the gas companies to make a lower B.t.u. gas and continue to charge the same price for this fuel as was charged for the higher B.t.u. gas. You must realize the fact that the American gas industry is a public utility institution and is allowed to earn only a fair and reasonable return on its investment. Any earnings which exceed this amount are reflected in benefits to the customer through lower rate schedules. In cases where gas companies are supplying a lower B.t.u. gas and where they are able to manufacture that gas at lower cost, such economies will ultimately be reflected in lower rates to the consumer.

It is, of course, obvious that 1 cu.ft. of 125 B.t.u. gas cannot do the work of 1 cu.ft. of 1,000 B.t.u. gas, and I do not believe that any of the gas companies have been trying to convey this

impression. The heat units of the different gaseous fuels vary in their quality, and for this reason it is found that in some cases the gas of a somewhat lower B.t.u. can be used just as efficiently as a gas of a higher B.t.u. For instance, in some localities it has been found that a gas of 525 B.t.u. functions as efficiently and economically as a gas of 600 B.t.u. for domestic purposes.

However, the broad and general claims of the gas industry are not along these lines. All they claim is that a lower B.t.u. gas can be used with as great effectiveness per B.t.u. as the higher B.t.u. gas. Therefore, in cases where a company can manufacture heat units of lower B.t.u. gas at lower cost than when making higher B.t.u. gas, it is obvious that such a method will work economies which will ultimately be reflected in better service at lower cost to the consumer.

COMBUSTION UTILITIES CORPORATION.

(Signed) A. L. KLEES.

Assistant to General Manager.
New York City.

To the Editor of Chem. & Met.:

SIR—In connection with your editorial published March 17, 1924, on "Determining the Quality of Industrial Gas" you should consider the article published in your magazine Nov. 12, 1923, on "Combustion," by Carl J. Wright. It seems that your editorial is written with only a superficial consideration of the subject. The gas industry has discovered that a lowering of B.t.u. per cu.ft. will lower the cost of manufacture more than proportionately and the value of the cu.ft. of gas to the consumer will not be proportionately less. It is impossible to explain this apparent anomaly without writing a treatise on the subject, and that has been done by others.

The interests of the gas industry are inseparable from the interests of the public and the industrial consumer. The object of a reduced B.t.u. basis is to provide the growing numbers of industrial users with a satisfactory fuel at a less prohibitive cost. It is the desire of the industry to provide gas at a B.t.u. per cu.ft. price, which is the basis of manufacturing costs, but this has never met with the approval of consumers or the rate-governing bodies, except very recently in England.

The interest the gas industry has taken in removing the present fixed B.t.u. basis is in anticipation of the fact that the future gas price will be on a B.t.u. basis, with consideration of the load factor; and this lowered B.t.u. basis will provide a heating fuel at less cost per B.t.u. to the consumer, less cost to manufacture, and will result in conservation of natural resources, which the present standards of manufacture waste.

The allowable B.t.u. should not be fixed, since with a variation in manufacturing materials and methods there are times when a 500 B.t.u. per cu.ft. gas costs less per B.t.u. to manufacture than a 395 and vice versa. This is the reason that a price on a B.t.u. basis with variable and lower B.t.u. per cu.ft. is the desire of both heat users and the gas industry. A constantly varying B.t.u. is obviously not desirable, but the gas industry desires the opportunity to raise or lower the B.t.u. per cu.ft. value of the gas when necessary to maintain the lowest possible cost to the consumer per B.t.u. and eliminate waste in manufacture.

The rate-governing bodies will never permit an excessive profit in the gas industry, hence it must be apparent, even to a superficial observer, that the desire to reduce and alter the B.t.u. standard is not prompted by selfish motives. RAYMOND L. PRESBREY.

Everett, Mass.

The gas industry should have full co-operation in providing "a heating fuel at less cost per B.t.u. to the consumer." But the idea that the lower B.t.u. gas will not have a proportionately lower value to the user still remains in the minds of most engineers as more than an "apparent anomaly." EDITOR.

Use of Inspection

To the Editor of Chem. & Met.:

SIR—I notice in your April 7 issue an editorial entitled "Use and Abuse of Inspection," and there are one or two discrepancies which I am inclined to believe should be called to your attention.

In the first paragraph you state that when a commodity is sold on the basis of specifications, it is often essential to make the inspection for acceptability of the product. In this same paragraph you state: "The work should become a matter of co-operation between buyer and seller, not a sleuthing effort." In the next paragraph I note your article relates to government inspections to some extent, and I therefore call your attention to the fact that where materials are purchased under competition and based upon specifications, it is very essential that the inspection should be of such a nature that the competitors can be assured that the material actually supplied conforms to the specifications, and this is not always as simple a procedure as might be inferred from your editorial.

An inspection based on samples selected by the inspector from special parcels set aside by the manufacturer would be practically worthless; in fact, this would practically amount to the manufacturer selecting his own test samples.

In the last paragraph, mention is made that purchasing agents cannot afford to deal with concerns in which they have no confidence. This statement would not tend to show a thorough knowledge of the methods of government purchases. In allowing competitive bids it is often necessary to consider the bid of a manufacturer who is not known to the purchasing agent,

and the only protection to the government under these circumstances is a careful inspection to be sure that the material complies strictly with specifications.

W. A. E. DOYING,
Inspecting Engineer,
The Panama Canal.

Washington, D. C.

Important Technical Articles in Foreign Literature

"The Lithopone Problem." J. Frere. *Rev. des prod. chim.*, vol. 26, pp. 253-6 (1923); *Chem.-techn. Uebersicht*, vol. 48, p. 48, March 22, 1924.

"Lithopone, I—The Chemical Mechanism of the Blackening of Zinc Sulphide in Light." E. Maass and R. Kempf. The theory is advanced, but not experimentally proved, that blackening in light is due to separation of finely divided metallic zinc at the surface. *Z. angew. Chem.*, 1923, p. 293; *Chem.-techn. Uebersicht*, vol. 48, p. 48, March 22, 1924.

"Germany's Foreign Trade in Chemical and Related Products in 1923." A statistical summary. *Chemiker-Zeitung*, vol. 48, pp. 145-8, 154-6, March 15 and 18, 1924. (To be continued.)

"Action of Chlorine on Cement and Concrete." Otto Gassner. A discussion of the reactions and conditions leading to chlorine deterioration of cement and concrete. *Chemiker-Zeitung*, vol. 48, pp. 157-8, March 20.

"Commercial Congo Dyes." W. Vaubel. Preparation, uses and analysis. *Chemiker-Zeitung*, vol. 48, p. 165, March 22.

"Some Industrial Uses of Silica Gel." F. Meyer. Uses as absorbent, as catalyst and as carrier for other catalysts. *Z. angew. Chem.*, 1924, pp. 36-8; *Chem. techn. Uebersicht*, vol. 48, p. 46, March 22.

"Dry Cooling of Coke." In the process of Sulzer Brothers Co., coke is cooled in ventilated chambers in an inert atmosphere. *Gas- und Wasserfach*, vol. 64, pp. 204-5; *Chem.-techn. Uebersicht*, vol. 48, p. 41, March 15.

"Portable Gas-Fired Industrial Furnaces." Joseph Schmidt. Various types of small furnaces are discussed. *Gas- und Wasserfach*, vol. 64, pp. 165-8; *Chem.-techn. Uebersicht*, vol. 48, p. 41, March 15.

"A German Sugar Monopoly." Bartens. It is reported that a sugar monopoly in the interests of the Entente is to be added to the existing monopolies in tobacco, alcohol, matches and beer. *Deutsche Zuckerindustrie*, vol. 49, p. 187 (1924); *Chem.-techn. Uebersicht*, vol. 48, p. 43, March 15.

"Raffinose." Schecker. Properties, uses and analysis. *Zeitschr. f. Zuckerindustrie*, vol. 74, pp. 82-5 (1924); *Chem.-techn. Uebersicht*, vol. 48, p. 43, March 15.

"Undetermined Losses in Beet Sugar Manufacture." H. Claassen. A loss of 1 to 1.5 per cent (in polarization, not in sucrose) is apparently unavoidable. Reported lower losses are to be doubted. *Centralbl. Zuckerind.*, vol. 32, p. 241 (1924); *Chem.-techn. Uebersicht*, vol. 48, p. 43, March 15.

"A Case of Spontaneous Combustion in Working With Dichlorethylene." H. Thron. In a flask of distillate (from alcohol containing about 0.25 per cent of ClHC:CHCl and some NaOH), the vapor above the liquid suddenly burned with a flash of very sooty flame which did not ignite the alcohol in the flask. The cause is considered to be the formation of chloracetylene, ClC:CH . *Chem.-Ztg.*, vol. 48, p. 142, March 15.

"Chromium-Plated Cathodes." G. Grube and A. Burkhardt. Very good laboratory results in the preparation of hypochlorites and chlorates have been obtained by use of chromium plated iron cathodes. Technical success will depend largely on the durability of these cathodes. *Z. Elektrochem.*, vol. 30, pp. 67-72 (1924); *Chem.-Ztg.*, vol. 48, p. 143, March 15.

"Recovery of Coal and Coke From Fuel Residues." A discussion of the Krupp-Gruson magnetic process. *Gas- und Wasserfach*, vol. 64, pp. 137-8; *Chem.-techn. Uebersicht*, vol. 48, p. 41, March 15.

"Fuel Recovery From Ashes." A description of the "Columbus" coke separator. *Gas- und Wasserfach*, vol. 64, p. 176; *Chem.-techn. Uebersicht*, vol. 48, p. 41, March 15.

"Constitution and Heat of Combustion." F. Kirchhof. The heats of combustion of aliphatic, olefinic and acetylenic hydrocarbons and of cyclic hydrocarbons containing ethylene groups are compared. *Chemiker-Zeitung*, vol. 48, pp. 113-4, March 5.

"Fuel Recovery in Chemical Plants." H. Blücher. A description, with drawings, of the equipment made by the Ambi Maschinenbau Aktien-Gesellschaft, Berlin. *Chemiker-Zeitung*, vol. 48, p. 115, March 5.

"Automatic Centrifugal Pumps." Ritter. A description, with drawings and curves, of the "Sihi" pump made by the Siemen & Hinsch Co., St. Margarethe, Holstein. *Chemiker-Zeitung*, vol. 48, pp. 116-7, March 5.

"Final Report on the Oppau Disaster." H. Kast. *Chemiker-Zeitung*, vol. 48, pp. 133-5, 158-60, March 13 and 20.

"Calculation of Heating Value." Otto Niezoldi. The most accurate formula is that given by Lunge-Berl, *Chemisch-technischen Untersuchungsmethoden*, ed. 7, Vol. I (1921). Other formulas are discussed. *Chemiker-Zeitung*, vol. 48, pp. 135-6, March 13.

New Publications

"STEINMETZ AND HIS DISCOVERER" is the title of a 24-page booklet just published by Robson & Adeo, Schenectady. The booklet was written by John T. Broderick, an early associate of Dr. Steinmetz in the General Electric Co., and at present employed there. He is also author of "Pulling Together," a book on industrial relations, containing an introduction by Dr. Steinmetz. Mr. Broderick points to E. Wilbur Rice, Jr., as the discoverer of Steinmetz, and their first meeting in a Yonkers workshop 30 years ago is described. An outline of the growth of the electrical industry during the past 20 years follows as a prelude to Mr. Broderick's description of the influence of the two men on electrical progress.

THE CHAMBER OF COMMERCE of the State of New York has published a list of Chambers of Commerce of the world exclusive

of the United States, together with names of secretaries and population of cities and countries, where ascertainable. This list is the first of its kind that has ever been available so far as is known. The introduction to the pamphlet is printed in English, French, Spanish, Portuguese, Italian, German and Esperanto. In securing the names of chambers, correspondence has been carried on with every section of the world, and every nation, colony, protectorate and major political division throughout the world is listed in alphabetical order. The purpose of the pamphlet is to assist business men in making a contact with business men in other countries. Copies can be had without charge by addressing the Chamber of Commerce of the State of New York, 65 Liberty St., New York, N. Y.

U. S. DEPARTMENT OF LABOR, Bureau of Labor Statistics, has issued Bull. 349 on "Industrial Relations in the West Coast Lumber Industry," by Cloice R. Howd.

NEW BUREAU OF STANDARDS PUBLICATIONS: Circ. 145, Summary of Technical Methods for the Utilization of Molasses, collated from patent literature, published Jan. 28, 1924, price 15 cents; Circ. 163, U. S. Government Specifications for Titanium Pigment, Dry and Paste.

NEW BUREAU OF MINES PUBLICATIONS: Bull. 225, Stone Dusting or Rock Dusting to Prevent Coal-Dust Explosions, as Practiced in Great Britain and France, by George S. Rice; Tech. Paper 344, Analyses of Ohio Coals.

"CHEMISTRY AND YOU" is the title of a new monthly house organ published by the Arthur R. Maas Chemical Laboratories, Los Angeles, Calif. It carries a message to the business man, showing him how to make money through the application of chemistry to industry. The first three numbers are full of human interest, items telling the story of industrial chemistry in the language of the layman. The publication is a welcome addition to a growing list of similar papers that are spreading the gospel of chemistry.

Books Received

Bibliographies

REFERENCE LIST OF BIBLIOGRAPHIES: Chemistry, Chemical Technology and Chemical Engineering Published Since 1900. Compiled by Julian A. Sohon, of the Engineering Societies Library, and William L. Schaaf. 100 pages. H. W. Wilson Co., New York. Price, \$1.50.

In beginning any investigation it is advisable to become familiar with the prior art as disclosed by the literature, and the discovery of a good up-to-date bibliography is invaluable in saving time. Bibliographies covering all phases of chemical technology have been gathered together to form this convenient reference book. It will be found of real value in getting at the sources of information on any subject within the field where previous investigators have prepared a bibliography. Even in cases where the bibliographies are not sufficiently comprehensive for the work at hand, they will serve excellently as starting points for more extended study.

Numerical Data

ANNUAIRE POUR L'AN 1924. Issued by the Bureau des Longitudes, Paris. 658 pages. Gauthier-Villars et Cie., Paris. Price (by mail), paper cover, 7 fr.; bound, 9 fr. 50.

To the list of sources of numerical data on chemistry and physics should be added the 220-page chapter in this year book published by the French Bureau of Longitudes. Many of the sections in this chapter have been contributed by specialists.

American Patents Issued April 1 and 3, 1924

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.*'s staff, and those which in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests, and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,488,915—Process and Batch for Making Sheet Glass. Frederick Gels-tharp, Tarentum, Pa., assignor to Pittsburgh Plate Glass Co.

1,488,918—Oleo Oil. Valentine Hechler, Chicago, Ill., assignor to Wilson & Co., Chicago.

1,488,929—Drier-Felt Stretcher. Duncan L. McCorkindale, Holyoke, Mass.

1,488,933—Method and Apparatus for Tire Manufacture. Thomas Midgley, Hampden, Mass., assignor to Fisk Rubber Co., Chicopee, Mass.

1,488,953—Drier. John O. Tensfeldt, Ridgfield, N. J.

1,488,964—Process for Producing Soda Containing Water of Crystallization or Mixtures Thereof With Other Substances. Adolf Welter, Krefeld-Bockum, Germany.

1,488,973—Method of and Means for Manufacturing Teacups, Breakfast Cups and Other Vessels or Articles of Pottery. Elijah Brookes, Stoke-on-Trent, England.

1,488,974—Apparatus for Treating Articles Made From Pulp. Orton B. Brown and Howard Parker, Berlin, N. H., assignors to Brown Co., Portland, Me.

1,488,993—Paste Composition. Charles J. Lindstrom, Chicago Heights, Ill.

1,489,001—Method of Treating Articles Made From Pulp. Howard Parker and Orton B. Brown, Berlin, N. H., assignors to Brown Co., Portland, Me.

1,489,008—Method of Separating and Purifying Minerals. Harry De Courcy Richards, San Francisco, Calif.

1,489,009—Process for the Expulsion of Volatile Substances by Means of Streaming Vapors. Martin Rohmer, Hofheim, near Taunus, and Karl Blumrich, Hoechst-on-the-Main, Germany, assignors to Farbwerke vorm. Meister Lucius & Bruning, Hoechst-on-the-Main, Germany.

1,489,021—Preparation of Metal Chlorides. James G. Stafford, Chicago, Ill., and Robert H. Gardner, Whiting, and Ernest B. Phillips, East Chicago, Ind., assignors to Sinclair Refining Co., Chicago.

1,489,023—Pot or Crucible. Arthur E. Bellis, Springfield, Mass., and Charles S. Collins, New York, N. Y., assignors, by mesne assignments, to the Bellis Heat Treating Co., New Haven, Conn.

1,489,026—Composition for Producing Glass. Alexander L. Duval, Washington, Pa.

1,489,032—Centrifugal Casting Apparatus. William L. Haynes, Burlington, N. J., assignor to United States Cast Iron Pipe & Foundry Co., Burlington, N. J.

1,489,036—Centrifugal Casting Mechanism. James B. Ladd, Ardmore, Pa., assignor to United States Cast Iron Pipe & Foundry Co., Burlington, N. J.

1,489,093—Welding Aluminum. Ralph D. Mershon, New York, N. Y., and Percy A. Ross, Norwalk, Conn., said Ross assignor to said Mershon.

1,489,099—Manufacture and Production of Gas-Tight Seals or Closures Between Metal and Vitreous Material. Frederick Reynolds, Walkerville-on-Tyne, England, assignor of one-half to Silica Syndicate, Ltd., Westminster, England.

1,489,109—Vapor-Removing Plant. Edouard Bataille, Paris, France.

1,489,181—Process for the Production of Albumose Solutions. Edmund Weidner, Berlin, Germany.

1,489,183—Production of Titanic Acid. Charles Weizmann and Joseph Blumenfeld, London, England.

1,489,213—Process of Improvement of Aldehyde Resins. Willy O. Hermann and Hans Deutsch, Munich, Germany, assignors to Consortium für Elektrochemische Industrie G.m.b.H., Munich, Bavaria, Germany.

1,489,223—Drying Machine. Christian H. Reumann, and Harold O. Kaufmann, Philadelphia, Pa., assignors to Philadelphia Drying Machinery Co., Philadelphia.

1,489,240—Voltaic Battery and the Production of Electrode Elements Therefor. Thomas A. Edison, Llewellyn Park, West Orange, N. J., assignor to Thomas A. Edison, Inc., West Orange.

1,489,243—Ferro-nickel-Chromium Alloy. Pierre Girin, Paris, France, assignor to Société Anonyme de Commentry, Fourchambault & Decazeville, Paris, France.

1,489,268—Manufacture of Margarine. Oluf Michelsen, Ealing, England, assignor to Maypole Margarine Works, Ltd., Southall, England.

1,489,315—Process of Making Cellulose Ether. John M. Donahue, Rochester, N. Y., assignor to Eastman Kodak Co., Rochester.

1,489,330—Paperlike Product and Process of Making the Same. Kirke L. Moses, Brookline, Mass.

1,489,340—Heat Insulation and Process of Making Same. Robert S. Blair, Sound Beach, Conn.

1,489,347—Production of Iron and Steel. Albert W. Davison, Parr, Va., assignor by mesne assignments to J. P. Laffey, trustee, Wilmington, Del.

1,489,354—Kier. Patrick W. Kiernan, Lowell, Mass., assignor to Lowell Bleachery, Lowell, Mass.

1,489,360—Process of Manufacturing Iron and Steel Direct From the Ore. Arthur J. Moxham, Odessa, Del., assignor, by mesne assignments, to J. P. Laffey, trustee, Wilmington, Del.

1,489,361—Production of Iron and Steel. Arthur J. Moxham, Great Neck, N. Y., assignor, by mesne assignments, to J. P. Laffey, trustee, Wilmington, Del.

1,489,380—Manufacture of Alkyl Derivatives. Walter Bader, Spondon, near Derby, England, and Donald Archer Nightingale, Cumberland, Md., said Bader assignor to American Cellulose & Chemical Manufacturing Co., Ltd., Inc., New York.

1,489,395—Refrigerating Apparatus. Fred E. Norton, Worcester, Mass., assignor to Jeffries-Norton Corporation, Worcester, Mass.

1,489,397—Combined Vacuum Producing and Boiler-Feeding Apparatus. Franklin M. Patterson, Bayonne, N. J.

1,489,420—Fractionating Tower for Pressure Stills and the Like. John E. Bell, Brooklyn, N. Y., assignor to Sinclair Refining Co., Chicago, Ill.

1,489,429—Chromium-Steel Alloy. Berton H. De Long, Springfield, Sinking Spring, and Frank R. Palmer, Reading, Pa., assignors to Carpenter Steel Co., Reading.

1,489,497—Catalyst. Alfred T. Larson, Washington, D. C., assignor to Arthur B. Lamb, trustee, Cambridge, Mass.

1,489,525—Manufacture of Magnesium Chloride. Victor Moritz Goldschmidt, Christiania, Norway.

1,489,546—Process for the Washing and Degumming of Fibers. Reuben Levi Pritchard, London, England.

1,489,554—Tunnel Kiln. Halver R. Straight, Adel, Ia.

1,489,564—Refiner for Wood Pulp. Einar Wahlstrom, Vittingfos, Norway, assignor to A/S Myrens Verksted, Christiania, Norway.

1,489,623—Paper-Making Machine. Ezekiel J. Wilson, East Greenbush, N. Y., assignor to F. C. Huyck & Sons, Rensselaer, N. Y.

1,489,695—Grinding Mill. William G. Burns, New York, and George G. Herz, Flushing, N. Y., assignors to Jabez Burns & Sons, New York.

1,489,707—Method of Subliming Benzoic Acid. Ralph H. McKee, New York.

1,489,724—Method of Producing Chemical Reactions. Gerald L. Wendt, Dayton, Ia.

1,489,725—Art of Preventing Loss by Evaporation From Storage Tanks. Robert E. Wilson, Chicago, Ill., assignor to Standard Oil Co., Whiting, Ind.

1,489,741—Process of Producing Phthalic Anhydride. Augustus E. Craver, Cliffside, N. J., assignor to The Barrett Co.

1,489,786—Machine for Disintegrating and Emulsifying Materials. Harry Povey, Stanmore, and Haldane Oswald Hallas, London, England.

1,489,787—Machine for Disintegrating or Emulsifying Materials. Harry Povey, Stanmore, England.

1,489,790—Process of Muffling Lithopone and Apparatus Therefor. Herman G. Schanche, Philadelphia, Pa., assignor to E. I. du Pont de Nemours & Co., Wilmington, Del.

1,489,814—Dyeing of Cellulose Acetate Artificial Silk, Films and the Like. Maurice Ernest Bouvier, Lyon, France, assignor, by mesne assignments, to La Société pour la Fabrication de la Soie "Rhodiaseta," Paris, France.

1,489,822—Method and Apparatus for Drawing Wire Glass. Joseph P. Crowley, Toledo, Ohio, assignor to Libbey-Owens Sheet Glass Co., Toledo.

1,489,823—Drawing Continuous Sheet Glass. Joseph P. Crowley, Toledo, Ohio, assignor to Libbey-Owens Sheet Glass Co., Toledo.

1,489,831—Air Filter. Anders Jordahl, New York.

1,489,846—Apparatus for Drying Disintegrated Material. Joseph O'Connell and Harold Hamilton Kerr, Kensington, Victoria, Australia.

1,489,852—Drawing Continuous Sheet Glass. Clifford A. Rowley, Toledo, Ohio, assignor to Libbey-Owens Sheet Glass Co., Toledo.

1,489,875—Drawing Continuous Sheet Glass. James Whittemore, Detroit, assignor to Libbey-Owens Sheet Glass Co., Toledo, Ohio.

1,489,876—Drawing Sheet Glass. James Whittemore, Detroit, Mich., assignor to Libbey-Owens Sheet Glass Co., Toledo, Ohio.

1,489,915—Manufacture of Acetaldehyde From Acetylene. Erich Baum and Martin Mugdan, Nuremberg, Germany, assignors to Consortium für Elektrochemische Industrie G. m. b. H., Nuremberg, Germany.

1,489,932—Heat Interchanger. Samuel J. Dickey, Los Angeles, Calif., assignor to General Petroleum Corporation.

1,489,940—Process and Apparatus for Treating Organic Materials to Make Meal and Oils. Stanley Hiller, San Jose, Calif., assignor to Stanley Hiller, Inc., San Jose, Calif.

1,489,974—Superheat Regulator. Benjamin Brodlo, New York, assignor to Superheater Co., New York.

1,490,020—Process of Preparation of Soluble Derivatives of Dioxarsenoaniline. Carl Oechslin, Paris, France, assignor to Etablissements Poulenc, Frères, Paris, France.

1,490,021—Manufacture of Aluminum Chloride and Pure Alumina. Alexandre Pedemonte, Toulon, France.

1,490,055—Process and Apparatus for Distilling Oil. Francis Sales Woldich, Sapulpa, Okla.

1,490,073—Accelerator for Rubber-Vulcanizing Process of Manufacturing Same and Vulcanizing Process. Norman Arthur Shepard and Justus Harvey Doering, Akron, Ohio, assignors to Firestone Tire & Rubber Co., Akron.

1,490,074—Shaker Screen. George M. Stedman, Aurora, Ind., assignor to Stedman's Foundry & Machine Works, Aurora, Ind.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

News of the Industry

Summary of the Week

Muscle Shoals offers to be explained to Senate Committee on Agriculture and Forestry, headed by Chairman Norris.

American Engineering Council announces activities and personnel of committees for coming year.

Paper industry to co-operate with Division of Simplified Practice, Department of Interior, in standardizing paper sizes.

Department of Commerce is gathering information with view of eliminating waste in use of chemical materials.

Co-operative purchasing of materials for importation may become common if Capper bill becomes a law.

House bill proposes to amend tariff act by placing practically all animal, fish and vegetable oils on dutiable list.

Many changes are made in regulation 60 of the national prohibition act.

Pennsylvania glass plant breaks production record for individual furnaces.

U. S. Patent Office to add 100 examiners to present staff.

To Eliminate Waste in Use of Chemical Materials

Information with regard to the maximum utilization of all chemical materials is being sought abroad by the Chemical Division of the Department of Commerce. The department's attention has been called frequently of late to opportunities that are presented to eliminate waste in the use of chemical materials.

The tendency to permit waste is particularly noticeable in processes where the chemical agent used constitutes a relatively small item of cost. In connection with tanning, for instance, the chemical material may be spent in so far as its principal tanning function is concerned, but the residue may be reclaimed and put in condition for further use in another connection.

It is known that an element which has contributed to Germany's chemical success is the ability to make the maximum use of all materials. Such a policy has been developed with marked success in this country by the packing industry. No small part of Henry Ford's success is said to rest on the application of this principle.

The American chemical industry has been so absorbed in more pressing problems that it has been necessary in many instances to allow certain wastes that are recognized as being avoidable. While there is an opportunity to eliminate waste in the manufacture of many chemical products, the chief saving likely to be effected in this connection is for chemists to follow chemical materials through other industries, with the idea of making such recovery as is possible after the major purpose of the material has been accomplished.

The reclamation of wastes has been reduced to a science in the packing industry, the rubber industry and in the textile trade. It is the hope of the chemical division to stimulate more

Byproduct Coke Production Runs Heavy

Byproduct coke production for the first 3 months of 1924 has equaled the average output during 1923, which was the record year for byproduct coke. U. S. Geological Survey figures just released show that the production continues in excess of 100,000 tons of byproduct coke per day. This is approximately 87 per cent of the capacity of the existing ovens, according to government estimates. The slight decrease in total coke output as compared with last year's average has all been absorbed by reductions in beehive coke.

thought along a similar line in the manufacture and use of chemicals. One of the steps to that end is the securing of typical examples of what has been done in Germany and other countries in that connection.

U. S. Patent Office Seeks 100 More Examiners

There are 200,000 applications for patents on inventions now pending in the United States Patent Office, according to a statement of the United States Civil Service Commission. To speed up action, Congress has authorized an appropriation that will permit the addition of 100 to the present examining force of 500.

The Civil Service Commission will hold examinations on May 7 and later dates for positions of assistant examiner in the Patent Office. The entrance salary is \$1,860 a year, and increases are provided up to \$5,000 a year.

Approximately 80,000 applications for patents are made annually.

Engineers Called On to Assist in Muscle Shoals Hearing

Responding to a request by Chairman G. W. Norris, the American Engineering Council, it is announced by ex-Governor James Hartness of Vermont, president of the council, has appointed a committee to make a study of special phases of the Muscle Shoals problem for the U. S. Senate Committee on Agriculture and Forestry.

The personnel of the engineers committee follows: F. R. Low, Harold Buck and Dr. Leonard Waldo, New York; Dr. H. E. Howe, Washington; E. B. Whitman, Baltimore; J. B. Davidson, Ames, Iowa; Prof. H. B. Walker, Kansas State Agricultural College, Manhattan, Kan.; Philip N. Moore, St. Louis, Mo.

Mr. Low is president of the American Society of Mechanical Engineers, of which Dr. Waldo is also a member. Mr. Buck is a member of the American Institute of Electrical Engineers, and Mr. Whitman the American Society of Civil Engineers. Mr. Walker and Mr. Davidson represent the Society of Agricultural Engineers.

The purpose of this limited engineering inquiry was set forth in the following letter from Senator Norris to the American Engineering Council:

"I would be very glad if through your organization a committee of competent engineers would make a report for the use of the Senate Committee on Agriculture and Forestry, covering the general economic phases on the Muscle Shoals development.

"After this committee has reported, I would like to have some of its members appear before the Senate committee so that they may be questioned in regard to their report and the general problem involved."

The engineering committee begins its sittings at once at the Cosmos Club, Washington.

Muscle Shoals Offers to Be Explained to Senate Committee

Senator Norris Seeks to Give Interested Parties Full Opportunity for Expression of Views—Schedule of Hearings Arranged

HEARINGS on the various proposals for the disposition of the government's projects at Muscle Shoals opened before the Senate Committee on Agriculture and Forestry April 16 with Elon H. Hooker as the first witness. The committee has arranged the tentative program which will carry the hearings through April 29 and the probabilities are that it will not be possible to conclude even on this date.

Senator Norris, chairman of the committee, at the opening of the hearings announced his policy that there should be full opportunity for all proposals to be presented in detail before the committee. The committee had previously reversed its prior announcement that no testimony regarding the Henry Ford offer would be heard, and voted to invite Mr. Ford to appear in person or to send an authorized representative to explain certain features of his bid. It is understood that several members of the committee are particularly anxious to have on record an authorized expression of Mr. Ford's intentions regarding the use of all the hydro-electric power that will be developed. There have been differences of opinion as to whether the Detroit manufacturer proposes to place industries of his own at Muscle Shoals which will consume all of the power or whether he intends to sell some of it for distribution to more distant points.

Hearings Scheduled

The following hearings have been scheduled to date, according to a statement by the committee:

April 16, Elon H. Hooker and associates. April 17, Elon H. Hooker and associates. April 18, Charles L. Parsons, C. T. Graff. April 19, F. G. Cottrell, Fixed Nitrogen Research Laboratory; J. W. Turrentine, Bureau of Soils. April 21, National Board of Farm Organizations; David B. Houston (former Secretary of Agriculture). April 22, Tennessee Manufacturers Association; Joseph H. Pratt, Western North Carolina Development Association, Asheville, N. C. April 23, Chamber of Commerce, Charlotte, N. C.; John A. McSparren, master, Pennsylvania Grange, Furnis Farm, Lancaster, Pa.; Engineers Association, Nashville, Tenn. April 24, Mississippi Development Board, Hattiesburg, Miss.; American Society of Civil Engineers; Federated American Engineering Societies. April 25, Newton D. Baker. April 26, W. T. Drummond, director, International Farm Congress, Kansas City, Mo.; Norris L. Cooke, Philadelphia. April 28, Henry S. Graves, Yale University; Harry A. Garfield. April 29, Gifford Pinchot, Harrisburg, Pa.

New Proposal to Be Made

A new offer will be presented to the committee by James T. Lloyd, a Washington attorney who was formerly a member of the House from Missouri.

This bill, of which the backers have not been named, has been drawn by J. H. Levering, a Los Angeles engineer, and is similar to the Morin bill, introduced in the last Congress. It provides for the creation of a corporation to be called the American Nitrate Corporation, with a capital stock of \$10,000,000, to lease and operate for 50 years the government plant at Muscle Shoals for the production of fertilizers, the generation of water power and contingent purposes. Of this corporation it is provided that there shall be five directors, two to be selected by the Secretary of Agriculture. The Secretary shall set the maximum price for fertilizers. Contracts for the sale of surplus water power are to be subject to the regulation of any state where the power is used. Preference right to purchase is to go first to states contiguous to the project, second to political subdivisions of these states, third to industries located therein, and fourth to power companies for resale. A research department is to be conducted in co-operation with the Departments of Agriculture and War. Work on the completion and equipment of the development at Muscle Shoals is to be begun by the corporation within 90 days of its authorization.

Hooker Explains Offer

In testifying before the committee, Mr. Hooker, who has made a proposal that involves government co-operation, explained his bid, which is incorporated in Senate bill 2747, introduced by Senator Wadsworth. Mr. Hooker, who is president of the Hooker Electrochemical Co. and is president of the Manufacturing Chemists Association of the United States, is associated in this bid with J. G. White, of New York, who constructed two of the Muscle Shoals units for the government, and with W. W. Atterbury, of Philadelphia, vice-president of the Pennsylvania Railroad.

The offer, Mr. Hooker said, contemplated maximum production and distribution of cheap fertilizer with an estimated saving to farmers of \$30,000,000 a year, and a return to the government \$305,000,000 in 50 years. The government would furnish all the capital for the operations and the company would put in \$1,000,000 as evidence of good faith, relieving the government at once of construction, operation, research and manufacture. The government would receive 75 per cent of the profits and 25 per cent would go to the company from fertilizer operations. Title of all properties would be made in the name of the government, Mr. Hooker said.

Mr. Hooker declared that specialized management was necessary at Muscle Shoals because of the rapid change in types of fertilizers for farm purposes. The highly concentrated fertilizer which he described contains five times as much plant food as ordinary fertilizer and he asserted it would reduce freight costs alone 80 per cent.

House Bill Provides Duties for Oils and Oilseeds

Would Place Import Tariff on All Vegetable Oils and Oil-Bearing Materials Now on Free List

Representative Wurzbach has introduced a bill, H.R. 8589, which is intended as an amendment to some of the existing paragraphs of the tariff act. The bill has been referred to the Committee on Ways and Means.

The proposed amendment first takes up the subject of animal and fish oils and specifies a duty of 5c. per gal. on animal oils, cod, herring, cod and menhaden oils; 6c. per gal. on whale and seal oils; 10c. per gal. on sperm oil; 20 per centum ad valorem on all fish oils, not specially provided for.

The bill carries provisions which would remove all vegetable oils and oilseeds from the free list. It seeks to amend paragraph 55 of the tariff act to read as follows:

"Par. 55. Coconut oil, 2c. per pound; cottonseed oil, palm oil, palm kernel oil, sesame oil, inedible, for mechanical and manufacturing purposes, 3c. per pound; peanut oil, 4c. per pound; soya-bean oil, perilla oil, Chinese tung oil, Japanese tung oil (known in commerce as wood or nut oil), 2½c. per pound; vegetable tallow and vegetable wax, ½ of 1c. per pound; and all other vegetable oils, not specially provided for, 25 per centum ad valorem."

Copra is included among the oil-bearing materials on which import tariffs are sought. According to Representative Wurzbach's bill paragraph 760 of the tariff act would be changed to read:

"Par. 760. Oil-bearing seeds and materials, castor beans, hempseed and soya beans, one-half of 1c. per pound; copra and palm nut kernels, one-half of 1c. per pound; palm nuts and perilla seed, eight-tenths of 1c. per pound; tung nuts and sesame seed, 1.3c. per pound; flaxseed, 40c. per bushel of 56 lb.; poppy seed, 32c. per 100 lb.; sunflower seed, 2c. per pound; apricot and peach kernels, 3c. per pound; cottonseed and rapeseed, one-third of 1c. per pound, and all other oil-bearing seeds and nuts, not specially provided for, 20 per centum ad valorem."

Ceramists Plan Long Trip

A trip of unusual interest has been arranged by the American Ceramic Society in connection with its summer meeting this year. It is planned to leave Chicago on July 21, returning on Aug. 16. Spokane, Seattle, Lincoln, San Francisco, the Yosemite Valley, Los Angeles and Grand Canyon are included as stopping points. Invitations have been received to inspect mines and plants at most of the cities where stop overs are planned.

If 125 reservations are made for the trip, either through the secretary, Ross Purdy, Ohio State University, Columbus, Ohio, or Fred B. Ortman, Tropico Potteries, Inc., Glendale, Calif., a special train will be chartered for the entire trip. It is announced that ladies and children are to be welcome and that reservations should be made prior to June 1.

Washington News

Changes in Regulations of National Prohibition Act

Regulations 60, issued by the Prohibition Unit, under authority of the national prohibition act, have been revised and will become effective May 1, 1924. This is the first revision of these regulations since Jan. 17, 1920, when the national prohibition act was put into effect. Many changes have been made, some of which are given below.

Hereafter authorized manufacturers of alcohol and other liquors, wholesale druggists and importers of wine may orally solicit orders and furnish price lists to persons qualified under the act.

The regulations with regard to dealing in taxpaid industrial alcohol in original stamped packages have been modified in order to permit the procurement of such alcohol by persons lawfully dealing in U.S.P. and N.F. preparations held to be intoxicating liquors, sales of which must be made in accordance with the regulations.

A person who desires to use liquor for manufacturing purposes in a custom bonded warehouse, class 6, must obtain a permit to procure liquor. Intoxicating liquor may be shipped tax free in bond to such warehouse for manufacturing purposes pursuant to permit to purchase. Shipments should ordinarily be allowed only for manufacturing products which are unfit for use for beverage purposes, but if alcoholic preparations, compounds or liquors, such as absolute alcohol fit for use for beverage purposes, are made therewith, such products may be exported under an export permit only.

Paper Industry Co-operates in Size Simplification

Members of the American Paper and Pulp Association, by unanimous action, have voted to back "to the limit" and to make "effective in the shortest possible time" the simplification of paper to eight basic sizes and weights recommended by the committee on simplification of paper sizes, according to William A. Durgin, chief of the Division of Simplified Practice, Department of Commerce. Mr. Durgin made this announcement after attending the convention of the association in the interests of a simplification movement which has been under way since 1921, when it was first undertaken at the Bureau of Standards. Approximately thirty leaders in the industry were represented.

The National Advertisers Association reported at the meeting that within 2 weeks 189 of 280 members circularized in regard to the support of the basic paper sizes had pledged their aid, and that 250 would do so. More than 35 per cent of the 300 members of the National Publishers Association, it was announced, had pledged their support to the program. Representatives of paper machinery manufacturers declared that that branch of the paper industry was in accord with any move-

ment which would lessen the variety of paper machinery; while the National Paper Trade Association sent a report that it not only approved the basic sizes but indorsed the present movement.

Prediction was made that the National Purchasing Agents Association, which had indorsed the tentative plans at its last convention, would follow the others at its forthcoming meeting in May.

Navy Men Pleased With Helium Purification Plant

The Navy Department is much gratified with the reports that have been received of the success of tests of the recently completed helium repurification plant at the Naval Air Station at Lakehurst, N. J. An increase in the lifting capacity of the navy airship "Shenandoah" by more than two tons bids fair to be the outcome of these tests that have resulted in a purified helium of 98.4 per cent, which is the highest purity percentage that has ever been obtained outside of a laboratory. This plant has an operating capacity of 20,000 cu.ft. per hour, and the results of its operations indicate that when the airship is ready to fly next month, helium with a purity of 98 per cent or more will be available for its inflation.

The original filling of helium gas for the airship, as it was received from the helium production plant at Fort Worth, Tex., had an average purity of about 93 per cent. On account of the high purity of the gas obtained after the operations of the repurification plant, it has been estimated that the total lift of the airship using the repurified gas will be 4.8 per cent greater than when originally filled with gas from the production plant in Texas. Considering the operating volume of the ship, this gives an increase in lift of over 4,400 lb.

Sicilian Sulphur Industry Improved in 1923

The production of Sicilian sulphur during the past 4 years was as follows: 1920, 206,570 tons; 1921, 240,069; 1922, 137,640; and 1923, 206,238. The greatly decreased output in 1922 was the result of enforced idleness in the mines, since stocks on hand could not be disposed of because of the competition by American sulphur interests. The agreement between the latter and Sicilian sulphur producers early in 1923 reopened some of the lost markets for Sicilian sulphur. Exports consequently increased to 217,172 tons for that year, as compared with 133,263 in 1922. These were largely from accumulated stocks and the improved situation encouraged mine owners to resume operations; nevertheless, stocks at the close of 1923 were smaller than at the end of 1922—245,201 tons as compared with 274,830 at the end of the preceding year.

This information is contained in a

report forwarded from Palermo by Consul Edward I. Nathan.

The report further says that the present prices of sulphur leave a very small margin over the cost of production, as local mining methods are still very primitive. Miners' wages are consequently low. This situation has already led to labor disputes and strikes, which, if continued, will greatly hinder local production.

Large Production of Carbon Black in 1922

G. B. Richardson, of the Geological Survey, has just issued a report on the production of carbon black from natural gas in 1922. He states that the domestic output amounted to 67,795,000 lb., over 13 per cent more than in 1921. In 1922, as in 1921, Louisiana and West Virginia produced more than 90 per cent of the total output. Louisiana maintained first place and increased its lead over West Virginia, owing to developments in the Monroe field.

Increased demand for carbon black during the latter half of the year, especially by the rubber industry for use in making tires, required practically all the product of the year and, in addition, between 12 and 15 million pounds that had been held in storage. The reported average price for the year at the plants was 8.6 cents a pound.

Summary of Statistics of Carbon Black, 1921-22

	1921	1922
Number of producers reporting.....	23	26
Quantity produced, lb.....	59,766,315	67,795,129
Value at plants:		
Total.....	\$5,445,878	\$5,819,618
Average per pound, cents.....	9.1	8.6
Estimated quantity of natural gas used, M cu.ft.....	50,565,000	53,629,000
Average yield per M cu.ft., lb.....	1.2	1.3

Bureau of Standards Seeks Men to Fill Vacancies

Applications are sought for three positions at the Bureau of Standards at salaries ranging from \$2,400 to \$5,000 a year. The duties of appointees will be in connection with original investigations in some field of bureau's work.

Applicants may choose from the following optional subjects: electrical engineering, mechanical engineering, civil engineering, chemical engineering, ceramic engineering, radio engineering, engineering of materials and any specialized line of engineering not included in any of the above.

Competitors will not be required to report for examination at any place, but will be rated on their general education and experience, special education and experience in the optional subject selected, and writings to be filed with the application.

Hearing on Carbide Freight

Proposed changes in the freight rates covering calcium carbide from Sault Ste. Marie, Mich., to various southern points have been ordered held in suspension until Aug. 12, to permit the Interstate Commerce Commission to investigate the proposed schedules. A hearing will be held May 13 at the Merchants' Association rooms, 233 Broadway, New York.

Centralized Buying of Materials May Govern Import Trade

Senate Bill Aimed at Foreign Control Over Rubber and Nitrate of Soda Would Encourage Co-operative Buying of Other Materials for Import

WHILE Senator Capper's bill "to enable persons in the United States to engage in co-operative purchasing, for importation into the United States, of raw commodities that are produced principally in foreign countries" is aimed chiefly at foreign control over rubber and nitrate of soda, it is believed that a large number of purchasing agencies will be formed under this legislation, should it pass.

So far as the metals are concerned, it is not believed that the same need for collective action exists as is the case in rubber and nitrate, yet it is fully expected that common buying agencies will be set up for many of the metals. The action would not be prompted so much by the hope of securing lower prices as by the economies that could be effected by centralized buying.

At times there has been complaint of manipulation of tin by British interests. Ordinarily there is no interference with competitive influences and American consumers are not called upon to pay excessive profits to foreign producers. Nevertheless it is believed that the purchase of all American tin through one agency would effect economies and would constitute an assurance against manipulation at the expense of American purchasers.

No complaints have reached officials in Washington as to any manipulation in the handling of antimony, another of the commodities of which foreign supplies are the sole source of American requirements. Nevertheless it is believed that economies can be effected in unifying purchases of antimony. In fact, the opinion is expressed that co-operative purchases are particularly advisable in the case of any commodity where production is largely from one country and under the control of closely associated interests.

Effect of the Bill

A somewhat different situation is presented in the case of manganese. The production of this mineral abroad, from which our imports are drawn, is largely in the hands of American interests. Some advantage might come from co-operative purchases of those supplies drawn from Turkey and the Caucasus. Large American purchases of graphite are made in Ceylon and Madagascar. So far as specialists in Washington know, there is no complaint as to unfair practices looking toward the enhancement of prices of that commodity.

While nickel is produced under close control, there have been no manifestations of vicious tendencies in so far as official investigations of the situation have disclosed. There would be double assurance against any unfair practices, it is pointed out, were there in existence an agency through which all purchases could be made. Such agencies

would be in much better position than are the individual purchasers to keep abreast with the general situation having a bearing on prices.

Cryolite is another of the essential materials closely held abroad. The Danes, however, have always handled their monopoly fairly and since purchases already are largely in the hands of one large consumer in this country, it seems improbable that there is need for any new agency in that trade.

In the case of quicksilver, a purchasing agency would be in a much better position to deal with the Spanish Government, which apparently is disposed to stand behind the producers in exacting all that the traffic will bear. A considerable portion of Austria's magnesite is produced under American control, but it is expected that advantages would follow collective buying of that commodity.

Great advantages could be obtained for American consumers, it is believed, if all purchases of chrome ore were made through a single agency.

Senator Capper is disposed to press his bill, which puts in legislative form the recommendations of the Department of Commerce. Due to the fact that the legislation would have widespread effect on industry, it is expected that rather extensive hearings will be held.

New Jersey Chemists Hear Talks on Glass

Glass was the topic of the evening at the April 14 meeting of the New Jersey Chemical Society, held at Stetters Restaurant, Newark. After dinner the following elections of officers were made for the coming year: President, David Wesson; vice-president, Herbert B. Baldwin; secretary, F. W. Zons; treasurer, Allan R. Cullimore; board of governors, A. Merz and W. A. Richey.

The speakers of the evening were A. E. Marshall, consulting chemical engineer, of Baltimore, on "The Development of Glass Manufacture and Industrial Uses of Glass," and George E. Ashby, Fellow of the New York Microscopical Society, on "Some Observations of the Decay and Devitrification of Glass."

It was brought out by Dr. Marshall that while glass has been made since from 2500 to 7000 B. C. it was not until 1880 that technology of industrial production began to grow. The development of American glass for industrial purposes was credited largely to Dr. Eugene Sullivan of the Corning Glass Works. The reason for this advance was attributed to the curtailment of supplies of Jena glass brought about by the war.

Slides were used by both speakers to illustrate the various phases in the life of glass, from fabrication to decomposition. In addition the "Romance of Glass" was described with movies.

American Engineering Council Announces Activities

Leading engineers, economists, educators and industrialists will direct the public service activities of the American Engineering Council, ex-Governor James Hartness of Vermont, president of the council, announced in making public the personnel of numerous committees and appointments of representatives to act with other national bodies here and abroad.

One of the chief tasks of the council during the year, Mr. Hartness stated, will be the prosecution of a country-wide campaign to conserve the forest reserves of the nation. The council will work with federal, state and other agencies in devising plans to forestall the grave economic consequences of permitting the nation's forests to dwindle.

A second main effort will be directed toward government reorganization, particularly the making over of the Department of the Interior, in which shall be centered the vast public works functions of the government.

J. C. Ralston of Spokane, Wash., was named chairman of the council's committee on reforestation and timber supply. Other members are: Samuel M. Kennedy and C. C. Thomas, Los Angeles; G. H. Wilsey, St. Paul; A. F. Ganier, Nashville; John S. Barelli, New Orleans; Dean M. E. Cooley, University of Michigan; C. E. Paul, Chicago; Dr. Raphael Zon.

Gardner S. Williams of Ann Arbor, Mich., heads the committee on government reorganization as related to engineering matters, composed of Francis Blossom, L. B. Stillwell and J. Parke Channing of New York, J. H. Finney of Washington, John Lyle Harrington of Kansas City, Mo., P. N. Moore of St. Louis, Max Toltz of St. Paul, and Hunter McDonald of Nashville.

F. K. Copeland, Chicago manufacturer, is chairman of the committee on elimination of waste in industry organized by Herbert Hoover. Dean Perley F. Walker of the University of Kansas and B. A. Parks of Grand Rapids, Mich., are the other members.

William McClellan, formerly dean of the Wharton School of the University of Pennsylvania, is chairman of the federal power committee, the members of which are E. B. Katte of New York, C. G. Adsit of Atlanta, F. G. Baum of San Francisco, Erskine Ramsay of Birmingham, Ala., C. C. Thomas of Los Angeles, and J. H. Finney of Washington.

The committee on patents, which will recommend reforms in the U. S. Patent Office, consists of E. J. Prindle of New York, chairman; F. P. Fish of St. Louis, A. E. Lindau of Buffalo, F. E. Flanders of Springfield, Vt., E. W. Rice, Jr., of Schenectady, N. Y., Charles A. Terry of San Francisco, and William Schwanhauser of New York.

Record Output of Explosives

Production of permissible explosives in the United States in 1923 totaled 60,371,314 lb., a new record, according to the Bureau of Mines. Previous record was almost 54,000,000 lb., in 1920.

News in Brief

Naval Stores Experiment Station Proposed—The Senate has passed a bill authorizing an appropriation of \$200,000 for the purchase of lands in Florida for the establishing of an experimental and demonstration forest in connection with the production of naval stores.

Breaks Record for Paper Production—The Algonquin Paper Co., Ogdensburg, N. Y., has established what is said to be a new world record for paper production for a single machine. During a continuous period of 24 hours, one machine unit at the mill produced a total of 102.9 tons of paper.

Boiler Compound to Travel Cheaper—Boiler preservative and scale-removing compounds in liquid form in the future are to take a fifth class instead of a fourth class freight rating and will be given the advantage of a minimum carload loading of 36,000 lb. This action has been taken in a decision handed down by the Interstate Commerce Commission on a complaint brought by the Garratt-Callahan Co., of Chicago, manufacturer and dealer in such compounds.

Houser Wins Industrial Relations Award—The first award made by Harvard University from an endowment of \$100,000, donated by the family and in memory of the late Jacob Wertheim to further the plans of the philanthropist in regard to the improvement of industrial relations, goes to J. David Houser, of the Bureau of Management Research, San Francisco. A nation-wide study of the problem is to be made by Mr. Houser, who is a graduate of Leland Stanford, Jr., University. Prof. F. W. Taussig, professor of economics at Harvard, was chairman of the committee of selection.

New Canadian Alcohol Co. Formed—Canadian Industrial Alcohol has organized a new subsidiary company known as Industrial Alcohol of Manitoba, capitalized at \$2,000,000. The president is W. R. Allan, president of the Union Bank of Canada, Winnipeg. It is the intention of the new company to manufacture industrial alcohol at Winnipeg for the Manitoba market, and a \$400,000 building has been purchased at a very low price.

Compound Discovered to Fight Blood Poison—Discovery of a mercury compound in the form of a red dye which, it is asserted, has produced remarkable results in apparently hopeless cases of blood poisoning has been announced by the Division of Chemistry of Medicinal Products of the American Chemical Society. This discovery is largely credited to Dr. A. C. White of Baltimore.

1925 Chemical Exposition Shaping Up—Reports for the Tenth Exposition of Chemical Industries, which will be held at the Grand Central Palace, New York, during the week of Sept. 28 to Oct. 3, 1925, state that all exhibit space on the main floor has been contracted for by chemical and chemical equipment companies; that most of the second floor

has been taken, as well as a portion of the third floor.

Mathieson Suit Now On—The report of the master who has heard the testimony presented in the suits involving Arnold, Hoffman & Co. of Providence, and the Mathieson Alkali Works, New York City, presents only a partial decision. Judge Brown of the United States District Court is now considering the case, in which there are substantially two suits pending; one by the Mathieson Alkali Works against Arnold, Hoffman & Co., for the betrayal of Arnold, Hoffman's duties as selling agent over a number of years and in a number of transactions; another suit by Arnold, Hoffman & Co., against the Mathieson for terminating the contract of agency and for failing to carry out contracts for the sales of commodities. The Mathieson's defence to this latter suit is that Arnold, Hoffman had already betrayed their duty as selling agent as set forth in the first suit named.

National Chamber of Commerce to Consider Resource Problems—A special group meeting, dealing with problems of major importance to industries of natural resources, will be held in connection with the coming convention of the Chamber of Commerce of the United States at Cleveland, May 6 to 8, according to an announcement just made. This group session will be held under the auspices of the chamber's natural resources production department, and indications are that it will be attended by a considerable number of lumbermen, coal operators, oil producers and mining men.

Glass Plant Breaks Records for Production

The American Window Glass Co. has established new production records at its plant at Jeannette, Pa., as a result of a special drive on two furnaces during the first week of April. Furnace No. 4 at the plant, the largest in the world, operates twelve machines, and during the week noted averaged 95.7 boxes per machine per shift for the entire period. This record-breaking output is all the more remarkable when it is considered that the furnace has been in operation for 4½ years without being shut down for cold repairs, said to be the longest period of service for any glass furnace; recent hot repairs made on the unit will insure another continuous period of operation for about 1½ years. The production attained during the week was considerably in excess of the rated capacity of the unit. Another furnace at the plant operates eight machines, and in the time mentioned averaged 77.4 boxes per machine per shift. This likewise is far more than the rated output of the furnace. It is stated that the record figures were made possible by the good quality of production and an exceptionally low percentage of breakage.

American Electrochemists Perfect Meeting Plans

Substantially no changes have been made in the plans for the spring meeting of the American Electrochemical Society at Philadelphia, April 24 to 26, since these were announced in *Chem. & Met.* of March 24, page 484.

It is announced in the official program for the meeting that registration will begin at the Bellevue-Stratford on Wednesday, April 23, at 6 p.m. The technical sessions to be held at the same hotel begin on Thursday and are arranged as follows:

April 24, Thursday, morning, Organic Electrochemistry; noon, Round Table Discussion on "Refractories for Electric Furnaces"; evening, informal supper parties.

April 25, Friday, morning, Electrodeposition Symposium; noon, Round Table Discussion on "Electrodeposition."

April 26, Saturday, morning, Continuation of Electrodeposition Symposium.

Acetate of Lime and Methanol Production in February

There was a decline in the output of acetate of lime and methanol in February as compared with the totals for January. In the case of methanol, stocks at the end of the month were less than at the end of January, but in the case of acetate of lime there was a very marked increase in stocks. Figures as given by the Department of Commerce show the following:

Acetate of Lime (in Lb.)			
	Production	Shipments (or Use)	Stocks, End of Month
Jan.....	13,420,193	9,022,250	23,401,511
Feb.....	13,172,610	8,548,032	27,493,950

Methanol (in Gal.)			
	Production	Shipments (or Use)	Stocks, End of Month
Jan.....	705,747	642,812	2,632,633
Feb.....	689,503	681,057	2,618,339

Trade Notes

H. Mart Smith, manager of the vegetable oil department of W. R. Grace & Co., left last week on a business trip to the Pacific Coast.

The Insecticide and Disinfectant Manufacturers Association will hold its midsummer meeting June 30 and July 1, at Montreal, Canada.

R. Wilhelm has associated himself with Adolphe Hurst & Co., Inc., and will take charge of the import branch.

C. A. Young, of the Lucey Manufacturing Co., has been appointed to take charge of standardization work for the American Petroleum Institute. For the present Mr. Young will have his headquarters at Houston, Tex.

The American Cotton Oil Co. has filed papers of dissolution, which completes the absorption of the company by the Gold Dust Corporation.

The Atlas Chemical Solvents Co., of New York, filed suit last Wednesday in the District of Columbia Supreme Court to test the validity of the government regulations restricting the amount of alcohol which may be withdrawn for industrial purposes.

Men You Should Know About

GEORGE W. CRAIG has been re-elected president of the North East Fire Brick Co., North East, Md.

F. M. DEBEERS has gone to the Sun-maid Raisin Co., at Fresno, Calif., as production executive and chemical engineer to develop new processes and produce new raisin products.

ARTHUR L. HALVORSEN, chemical engineer, of Perth Amboy, N. J., left for Norway, April 16, and can be addressed at Neuberg gd. 6, III, Christiania, Norway.

W. E. HUNTER, formerly connected with the Economy Tumbler Co., Morgantown, W. Va., is now general manager of the Davies Glass & Manufacturing Co., Martins Ferry, Ohio.

W. S. JAMES, who has been chief of the automotive engine section of the Bureau of Standards, has resigned to accept a position with the Hupp Motor

Co. Mr. James will assume his new duties about the first of May.

EDWARD K. JUDD has become identified with the Union Carbide & Carbon Co., being engaged in the research laboratory of that company's Long Island City, N. Y., plant.

CHARLES P. KELLEY has been elected vice-president in charge of manufacture of the A. C. Lawrence Leather Co. and the National Calfskin Co., both of Peabody, Mass. He has been connected with the two companies for about 20 years, most of the time as general superintendent of tanneries.

Dr. E. H. KILHEFFER, vice-president of the Newport Chemical Works, Inc., Passaic, N. J., gave one of the principal addresses at the annual convention of the National Association of Hosiery and Underwear Manufacturers, Philadelphia, Pa., April 9, speaking on the subject of the process of bleaching and dyeing.

E. D. LIBBEY has been re-elected president of the Owens Bottle Co., Toledo, Ohio, and W. H. Boshart has been re-elected vice-president and general manager.

A. W. MANGUM, for the past 4 years process chemist with Lever Brothers Co., soap manufacturer, Cambridge, Mass., has recently resigned. Mr. Mangum was previously chemical supervisor of soap making with the Procter & Gamble Co., Cincinnati, Ohio. He contemplates engaging in business for himself.

THEODORE MAYNZ, for a number of years in charge of tests and efficiency for the Cleveland Illuminating Co., has opened a consulting office at 3326 Kenmore Road, Shaker Heights Village, Ohio. He will confine his attention to problems concerning the efficient generation and use of steam in industrial plants.

A. M. McQUEEN, vice-president of the International Petroleum Co., New York, has returned to his desk after 3 months absence in South America, particularly at company properties in Peru and Colombia.

C. WILBUR MILLER, president of the Davison Chemical Co., Baltimore, Md., has returned from a brief visit to England.

J. C. PEARSON, who has been for more than 12 years chief of the cement section of the Bureau of Standards, has resigned. On May 1 Mr. Pearson will assume his duties in his new position with the Lehigh Portland Cement Co., with headquarters at Allentown, Pa.

ARTHUR H. SMITH, instructor of physiological chemistry at Yale University, New Haven, Conn., has been appointed an assistant professor in that subject, effective April 1.

R. E. J. SUMMERS, formerly assistant technical engineer for the H. K. Ferguson Co., industrial engineers, Cleveland, Ohio, has been appointed chief engineer for the company and has

left for Japan, where he will be located for the next 3 months, looking over industrial contracts which the company has there.

ARCHIL B. WILLIAMS, aged 22, a chemist connected with the laboratory and research department of the National Carbon Co., Cleveland, Ohio, has been missing from his home for the past 3 weeks. Friends are very anxious to locate Mr. Williams, whose wife is reported very ill.

Obituary

RAYMOND M. HOWE, prominent in the refractory branch of the ceramics industry, died at his home in Edgewood, Pa., April 1, aged 30 years. He was graduated from Alfred University, Alfred, N. Y., and immediately following, in 1915, entered the graduate school of the University of Pittsburgh. In 1917 he was appointed senior industrial fellow in the Mellon Institute of Industrial Research and engaged ac-



Raymond M. Howe

tively in investigations of refractory products in close association with the Refractories Manufacturers' Association. He later became connected with the Kier Fire Brick Co., Pittsburgh, as technical assistant to the president, which position he occupied at the time of his death. He was elected vice-president of the American Ceramic Society at the annual convention in February last, and had been a member of the board of trustees of the organization for several years.

FRANK L. HOWES, of Brookline, Mass., well known in the sole leather industry, died at his residence, April 9, aged 57 years. At the time of his death he was treasurer of the Howes Brothers Co., Boston, one of the largest concerns in the sole leather field; he was also a director of the Michigan Tanning & Extract Co., the Pocahontas Tanning Co. and other leather tanning and chemical companies.

Calendar

AMERICAN ASSOCIATION OF CEREAL CHEMISTS, Curtis Hotel, Minneapolis, Minn., June 9 to 14.

AMERICAN CERAMIC SOCIETY, summer meeting and tour, July 21 to Aug. 18.

AMERICAN CHEMICAL SOCIETY, annual meeting, Washington, April 21 to 25.

AMERICAN ELECTROCHEMICAL SOCIETY, Hotel Bellevue-Stratford, Philadelphia, April 24 to 26.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Denver, Colo., July 15 to 18.

AMERICAN INSTITUTE OF MECHANICAL ENGINEERS, Cleveland, May 26 to 29.

AMERICAN LEATHER CHEMISTS ASSOCIATION, Spring Lake, N. J., June 18 to 20.

AMERICAN OIL CHEMISTS SOCIETY, New Orleans, La., May 5 and 6.

AMERICAN PAPER AND PULP MILL SUPERINTENDENTS ASSOCIATION, Dayton, May 22 to 24.

AMERICAN PHYSICAL SOCIETY, Washington, April 25 to 26.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Cleveland, Ohio, May 26 to 29.

AMERICAN SOCIETY FOR STEEL TREATING, Moline, Ill., May 23 to 25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Atlantic City, June 23 to 28.

AMERICAN WELDING SOCIETY, Engineering Societies Bldg., New York, April 22 to 24.

AMERICAN ZINC INSTITUTE, Hotel Chase, St. Louis, Mo., April 28 and 29.

CANADIAN INSTITUTE OF CHEMISTS, Queens University, Kingston, Ont., May 27 to 29.

MANUFACTURING CHEMISTS ASSOCIATION, annual meeting, India House, New York City, June 4.

NATIONAL ASSOCIATION OF PURCHASING AGENTS, Boston, May 19 to 24.

NATIONAL FERTILIZER ASSOCIATION, Kenilworth Inn, Asheville, N. C., June 9 to 14.

NATIONAL FIRE PROTECTION ASSOCIATION, annual meeting, Atlantic City, N. J., May 13 to 15.

NATIONAL LIME ASSOCIATION, White Sulphur Springs, W. Va., May 20 to 23.

TAYLOR SOCIETY, Cambridge, Mass., April 24 to 26.

WORLD POWER CONFERENCE, London, June 30 to July 12.

SOCIETY OF INDUSTRIAL ENGINEERS, Buffalo, April 30 to May 2.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION, Boulder, Colo., June 25 to 26.

Market Conditions

Lower Market for Metals Influences Prices for Derivatives

Improvement Reported in Small-Lot Buying—Heavy Arrivals During Week of Foreign Chemicals

THERE was an easier tone in the market for metal salts as a result of lower prices for some of the metals. Tin oxide responded by a decline of 3c. per lb. from the previous selling price. There were rumors that the lead salts had been reduced but this was not the case, although an easier feeling ruled in the case of many metal products.

It was noted that a wide assortment of chemicals and allied products came in, during the week, from foreign markets. This emphasizes the importance of foreign chemicals and accounts in a measure for the competition which confronts sellers. Most of the foreign-made chemicals were on a steady price basis with forward positions also steady.

A good delivery to domestic industries is reported in the case of many heavy chemicals. The fact that consumers are covered ahead has the effect of slowing up trading in the spot market and this is made more pronounced by the backward position of some industries. Slow call for stocks is reported from some branches of the textile and leather trades. Reports from the rubber and glass industries are more optimistic. It is also noted that sales of fertilizer for the season ended April 1 were more than 200,000 tons in excess of those for the previous year.

The weighted index number for the week was lower under the influence of reduced prices for crude cottonseed oil. As far as the generality of chemicals was concerned, there was no important price movement, though the tendency appears to be toward lower average levels.

There is considerable interest in arsenic and calcium arsenate but this does not extend to the trading market and neither of these commodities is active. Reports have been current to the effect that a large mineral oil company would put out a product for weevil prevention. These reports, while they mean nothing as far as immediate aid is concerned, have an effect of restraining buying of arsenate.

Acids

According to compilations made by the Geological Survey 6,631 tons of fluor spar were used in making hydrofluoric acid in 1923 as compared with 4,782 tons in 1922. At present stocks of hydrofluoric acid are fairly large and prices have been easy in tone.

None of the acid group has moved in any decided way within the week. Moderate buying is reported for some selections but in general demand is not active. Sulphuric acid has been moving more freely but offerings are large and values have not steadied. According to statistics for the fertilizer industry, consumption of acid in that line was larger than in the preceding year.

Tin Oxide Prices Reduced—Imported Caustic Potash Firmer—Arsenic Dull and Easy—Lead Products Unchanged but Easier in Tone—Prussiate of Soda Lower—Formaldehyde Marked Down—Nitrate of Soda in Rather Small Supply

Different consuming lines have been drawing on muriatic and nitric acids and stocks are said to have been reduced. Oxalic acid is in a position where prices are dependent on sellers' desire for business. In some cases resale lots have sold at low figures but in general, first hands are responsible for quotations and are competing keenly for round lot orders. Citric and tartaric acids are in fair request with prices about steady.

Potashes

Bichromate of Potash—While there have been reports of price cutting in this market, the majority of reports indicate a lack of selling pressure and a steadiness of price. Some producers of bichromates have no stocks of potash and in all producing quarters the output has been cut down. Hence there is very little selling pressure and quiet consuming demand has no depressing effect on values. Asking prices range from 9½c. to 9¾c. per lb.

Caustic Potash—Low priced offerings have been well absorbed and prices for shipment from abroad have been higher. As a result the spot market has been advanced in price and 6¾@7c. per lb. is asked. Futures are quoted at practically the same figures as spot material.

Permanganate of Potash—While buying is irregular it is stated that some good sized lots have been taken out of the market. Reports from foreign markets continue to quote high prices for

shipment from abroad and this places the market largely in control of domestic producers. Prices are on a steady basis at 14@14½c. per lb. according to seller, quantity, and packing.

Prussiate of Potash—Moderate sized lots of yellow prussiate sold at 19½c. per lb. in the spot market. Reports have been heard that spot material could be bought under 19c. per lb., but these reports were not borne out when buying orders appeared. It is possible that 19c. per lb. could be done on round lot business but stocks in some quarters were limited and this made prices less dependent on quantity. Shipments from abroad were quoted at 18½@19c. per lb. Red prussiate was quiet at 40@42c. per lb.

Sodas

Bichromate of Soda—Call for delivery against contract is taking large amounts into consumption. New business is not heavy. Market prices have undergone no change. Quotations are 7½@8c. per lb. according to quantity. Export inquiry is said to be fair and there are quotations of 7½c. per lb. for export business. Sellers are said to be giving concessions in order to gain export orders.

Caustic Soda—There were reports of price shading on small lots for the domestic trade but this was said to be exceptional and in the majority of cases the full quoted prices are the basis of sales. This is also true as far as first hands and large lot business are concerned. Contract price is steady at 3.10c. per lb. in carlots, at works. On export business the quotation is 3@3.05c. per lb., f.a.s. New York. The inside price is not firm as some sellers have shown a willingness to deal on private terms.

Nitrate of Soda—Large consumers have been well covered ahead but there has been a call for spot nitrate and prices have shown a tendency to harden because of the light stocks on hand. Reports from markets in the North agree that holdings are small and prices are nominally quoted at \$2.70 per 100 lb. Reports from Southern markets say there has been a good call for spot nitrate and stocks there also are limited. As a result sales are said to have gone through as high as \$2.75 per 100 lb. Interest is confined to spot material with no price changes in forward deliveries.

Nitrite of Soda—Most of arrivals from abroad are sold ahead and the spot supply has held at low levels. Trading in spot and nearby is quiet but the fact that stocks are small holds prices on a steady level. Quotations are 8½@8¾c. per lb.

Prussiate of Soda—In spite of reports that lower prices have encouraged

trading, it is stated that the market has remained dull and prices have eased off still further. In some quarters spot prussiate was offered at 10c. per lb., and shipments from abroad at 9½c. per lb. These prices were lower than those quoted by the majority of sellers but the undertone to the market is easy and buyers are favored.

Miscellaneous Chemicals

Arsenic—There is no stable price for arsenic in the spot market. First hands are quoting 11c. per lb. for domestic and this figure also represents the asking price of different importers. In still other directions prices have been sacrificed to dispose of holdings and values for spot goods are described as ranging from 9½c. to 11c. per lb. Buying is not active and the call for stocks which was expected to start in during March has failed to appear. Forward positions also are quiet with May forward shipment from Japan offered at 8½c. per lb. Calcium arsenate is moving quietly. For prompt shipment from works there were sellers at 11c. per lb., but for later shipments 11½c. per lb. seemed to be an inside figure. Reports from Georgia indicate that the state is selling to farmers there at 12c. per lb.

Bleaching Powder—New business has continued quiet and buying for export, which had increased at the beginning of the year, is now slow. Contract deliveries are being taken with regularity and this is one of the encouraging features of the market. The uplift in prices in the past 3 months has not been favorable for an expansion in trading. Reports regarding stocks in sellers' hands differ but it is generally held that supplies are considerably below those of this time last year. Current prices are \$1.90 per 100 lb. for carlots, at works. Liquid chlorine is offered at 4½c. per lb., in tank cars, and 5½c. per lb., in cylinders, f.o.b. works.

Formaldehyde—Some sellers reduced the price for carlots to 10½c. per lb. Others were holding 11c. per lb. as an inside figure. This difference according to seller was a feature of the market, but the inside figure was openly quoted and no difficulty was found in buying at that level.

Acetate of Lime—Reports have been circulated to the effect that prices would be further reduced but prominent sellers say there has been no change in quotations and they continue to ask \$3.50 per 100 lb. Production in February was 13,172,610 lb., shipments 8,548,032 lb., and stocks at the end of the month were 27,493,950 lb. which compares with stocks of 14,498,522 lb. at the end of February, last year.

Sal Ammoniac—There was very little change in the market during the week. Some goods afloat were offered at 6½c. per lb. and this gave an easy tone to the spot market but spot holdings were generally held at 6½c. per lb. On shipments from foreign markets 6½c. per lb. was asked but it was possible that 6½c. per lb. could be done. Imported gray was offered at 7½@7¾c. per lb. Lump was quoted at 12@12½c. per lb. according to quantity and packing.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	157.62
Last week	158.61
April, 1923	180.00
April, 1922	158.00
April, 1921	140.00
April, 1920	261.00
April, 1919	231.00
April, 1918	286.00

Higher prices for nitrate of soda and miscellaneous chemicals were offset by the decline in tin oxide and crude cottonseed oil. The weighted index number shows a decline of 99 points for the week.

Tin Oxide—The market was featured by a drop in price of 3c. per lb. This made the revised selling price 55c. per lb. The decline followed as a result of a lower market for the metal. Lower prices also were helped along by the fact that recent rises in price had checked buying and had brought out

price cutting on the part of some sellers. There was no change in the quotations for tin crystals or bichloride of tin.

Alcohol

According to the figures compiled by the Department of Commerce the stocks of methanol on the last day of February were 2,618,339 gal., compared with 2,044,429 gal. a year ago. Production of methanol in February was placed at 689,503 gal., which compares with 705,747 gal. in January and 730,590 gal. a year ago. The market was unsettled, but first hands announced no changes in the selling schedule. Pure methanol was maintained in most instances at 90c. per gal., tank car basis.

Denatured alcohol was in fair request and steady prices prevailed in this market. Producers quote 44½c. per gal. on the completely denatured, formula No. 5, in drums, carload lots, prompt shipment.

Coal-Tar Products

Firm Market for Benzene—Refined Naphthalene and U.S.P. Phenol Unsettled—Aniline Oil and Salt Steady

PRODUCTION of byproduct coke in the first quarter of 1924 amounted to approximately 9,175,000 tons, the total being equal to the quantity produced in the corresponding period a year ago. This indicates that the output of coal tar in the 3 months ended March 31 reached the total of 105,500,000 gal. Trading in the past week was not active. Benzene continued firm, production in most directions being sold up on contract. Offerings of solvent naphtha and toluene for immediate shipment were light. Refined naphthalene was unsettled, competition for business pending resulting in price concessions. Phenol was available for nearby delivery in a larger way and sentiment in buying circles was easier, although prices named underwent little change. Cresylic acid was firmer abroad, but this did not improve matters here. First hands reported a steady market for aniline oil.

Aniline Oil—Routine business was put through on the basis of 16c. per lb. for carload lots. The undertone remains steady, stocks being moderate. Aniline oil for red was nominally unchanged at 40c. per lb. Aniline salt was available at 22@23c. per lb., according to quantity and seller.

Benzene—With a period of good consumption ahead the market for benzene held on a firm selling basis. According to trade authorities production of benzene during the first quarter of the year was fully as large as in 1923. The end of the quarter found stocks low, reflecting general improvement in the demand for the motor fuel grade. Leading interests quote 23c. per gal. on the 90 per cent, and 25c. per gal. on the pure, tank car basis, works. Some of the smaller factors asked a premium on prompt shipment material.

Creosote—Manchester, England, reported freer offerings and unsettlement in prices. There were offerings

of creosote oil for shipment from abroad on the bulk basis of 8d. per gal. Exports from the United Kingdom for the first 2 months of the year amounted to 7,279,450 gal., compared with 6,296,452 gal. for the corresponding period in 1923. There were no important changes in the domestic situation.

Cresylic Acid—Several shipments arrived from abroad in the past week. The market was irregular, prices depending upon quality and seller. Business showed improvement in some directions, but competition was keen and offerings fairly liberal. The fact that foreign markets steadied had little influence upon traders here. Quotations named ranged from 65@70c. per gal. The English market on 60 per cent acid closed around 2s. 3d. per gal.

Dinitrotoluene—Offerings were reported at 18c. per lb., which compares with 20c. asked a short time ago.

Naphthalene—Demand for refined has shown improvement, but with stocks ample and no change in the market for crude, offerings have come out at lower prices. There are sellers of refined flake for shipment on the carload basis of 5½c. per lb., the customary premium obtaining on ball naphthalene. Chips are nominal at 5c. per lb. on white material, with demand quiet. Crude was offered for shipment from abroad at 2@2½c. per lb. for good quality stock.

Phenol—Nearby material sold at 28@29c. per lb., in drums, indicating that the market was easier in tone. Consumers have not yet covered for summer and fall requirements, and this lack of buying interest tends to unsettle the market. There were offerings of July forward material at 26c. per lb., in drums, with a possibility of doing even better on a contract extending over the remainder of the year.

Vegetable Oils and Fats

Cottonseed Barely Steady—More Buying Interest in Linseed Oil—Palm Oils Higher Abroad—Greases Firm

THERE was a better call for linseed oil for nearby delivery and crushers reported business in round lots for April-May-June shipment at slightly higher prices. No important change in prices occurred in either crude or refined cottonseed oil. China wood steadied on smaller spot offerings. Palm oils closed slightly higher in the forward positions. Tallow was steady, and choice grades of greases were firm. Oleo stearine advanced sharply. Fish oils were neglected.

Cottonseed Oil—The market for cottonseed oil was a narrow affair all week, with prices barely steady. Crude sold in the Southeast early in the period at 8½c. per lb. tank cars, f.o.b. mills, but later bids were reduced to 8¼c. per lb. In Texas 8½c. was the nominal closing price for crude. On Thursday refined prime summer yellow oil in the New York option market was quoted at 10.55c. bid, which compares with 10.65c. bid a week ago. Switching of May oil into the July and September positions accounted for much of the business. The fact that one refiner was rather anxious for May oil supported the market and discouraged selling on the part of bears. Reports of improvement in cash business in oil were circulated freely and claims of 200,000 bbl. consumption for April were made by those expecting higher prices. Lard in Chicago did not move much one way or the other. Stocks of pure lard in the Chicago district on April 15 amounted to 36,854,668 lb., compared with 33,141,846 lb. on April 1. Lard compound was higher, closing at 12@12½c. per lb., carload basis.

Corn Oil—The market held steady at the recent advance. Recent business was placed at 8½c. per lb., tank cars, Chicago, but at the close 9c. was asked in all directions.

Coconut Oil—Offerings came out at a reduction of ¼c. per lb. Several sellers of Ceylon type oil who held out for 8½c. per lb., tank cars, Pacific coast points, a week ago, now are asking 8c. per lb., all positions. In New York 8½c. was asked, sellers' tanks, with a possibility of 8¼c. being accepted on a bid. Manila oil for shipment in bulk was offered at 8c., c.i.f. New York, and at 7½c. per lb., c.i.f. San Francisco. Copra was quotably unchanged, prompt shipment from Manila closing at 5c. per lb., c.i.f. Pacific coast ports. In New York the market settled at 5¼@5½c. per lb.

Linseed Oil—Some good buying developed in April-May-June shipment oil at prices that were 1c. per gal. higher than a week ago. In other words April sold at 89c. per gal., cooperative basis, while May-June sold at 88c. per gal. Prompt shipment oil was available at 90c. throughout the week, although several crushers quoted 91c. because of the fact that they had no surplus to offer. Shipments of linseed oil from the mills since the first of the year compare favorably with shipments in the corresponding period a year ago.

A large part of the oil shipped out during the first quarter was sold last fall at much lower prices. No important change took place in the flaxseed situation. American crushers were buyers in the Argentine, thereby supporting prices. Argentine seed on spot (New York) sold at \$1.90 per bu., in bond. The May option in the Buenos Aires market held around \$1.60 per bu. At Duluth May seed closed at \$2.40½ per bu., while September settled around \$2.21 per bu. Shipments of flaxseed from the Argentine from Jan. 1 to April 11 amounted to 26,626,000 bu., compared with 23,224,000 bu. a year ago. Cake for export sold for early

Larger Imports of Copra and Castor Seed

Imports of castor seed and copra for the 8 months ended Feb. 29 were larger than a year ago. Arrivals of flaxseed from foreign countries fell off, but this was more than offset by increased domestic production. Receipts of domestic flaxseed so far this season amounted to 13,500,000 bu., compared with 7,500,000 bu. a year ago. Imports of oilseeds for the 8 months period, with a comparison, follow:

	1923-24	1922-23
Cottonseed, lb.	76,332,635	*52,042,248
Castor seed, lb.	43,995,043	41,792,659
Copra, lb.	216,759,456	198,277,530
Flaxseed, bu.	9,158,677	11,833,121

* Beginning Sept. 22, 1922.

May shipment at \$33.50 per ton, f.a.s. New York. Demand for meal improved and the market steadied.

China Wood Oil—Early in the week spot material sold down to 13¼c. per lb., cooperative basis. The market was a nominal affair at all times and prices covered a wide range, some sellers asking as high as 14¼c. per lb. China wood oil for May-June shipment from the Pacific coast in tank cars settled around 13c. per lb. Oriental markets were firmer and this discouraged speculative selling.

Olive Oil Foots—The past week witnessed heavy importations of foots. The market was unsettled on offerings of ex-dock material, several parcels selling at concessions. Most of the material that came forward went to consumers against contracts made some time ago. The nominal quotation at the close was 9¼c. per lb., all positions. There was no buying interest in futures.

Palm Oil—Demand subsided, but importers did not care to force matters as offerings from the other side were not so numerous. Asking prices were slightly higher on all grades. Lagos oil for shipment from Africa closed at 7.18c. per lb., c.i.f. basis, while Niger settled at 6.60c. per lb., c.i.f. terms. Refined deodorized oil was available for shipment at 9¼c. per lb., bulk basis, c.i.f. New York.

Palm Kernel Oil—There were offerings of English oil for shipment from the other side at 8¼c. per lb., in bbl.

Rapeseed Oil—Refined oil for April shipment from abroad was firm at 83@84c. per gal. On May forward the market was nominal at 81@82c. per gal.

Soya Bean Oil—A little inquiry developed, but prices appeared too high. Crude oil held nominally at 10@10½c. per lb., tank cars, duty paid, Pacific ports, and at 10½c., New York.

Tallow, Etc.—Last sales of extra special tallow went through at 7½c. per lb., with the undertone steady. Choice yellow grease sold at 6¼c. per lb. Oleo stearine sold at 10½c. and later at 10¾c. per lb. No. 1 oleo oil was offered at 12c. per lb.

Miscellaneous Materials

Antimony—It was reported that spot antimony, Chinese, was available at 9¼c. per lb., but most handlers held out for 10c. There was a fair demand. Cookson's "C" grade held at 12½c. per lb. Chinese needle nominal at 8½@9c. per lb. Antimony oxide 9¼@10c. per lb.

Barytes—The movement of floated material against contract continues good and prices are steady. White floated was nominally unchanged at \$23 per ton, f.o.b., St. Louis. Crude held at \$8@8.50 per ton, mines.

Blanc Fixe—Producers offered the dry at 3¼c. per lb., in bbl., carload basis, prompt and forward shipment from works.

Feldspar—No. 1 crude in North Carolina was offered at \$6.50@7.50 per ton, with the No. 2 at \$4.50@5.50, per ton.

Glycerine—Chemically pure sold at 17c. per lb., in drums, indicating that prices continued firm. Crude soaplye was offered sparingly at 11@11½c. per lb., loose, f.o.b. point of production. In the West dynamite was offered at 16½c. per lb., which compares with 16¼c. per lb. a week ago.

Naval Stores—Demand for spirits of turpentine was disappointing and prices eased off, the market closing at 99c. per gal., in bbl., ex yard New York. Rosins, however, were in good request and prices ruled steady on all grades. Demand for high grade material was especially good.

Lithopone—Production is well sold up and prices are firm on the basis of 6¼@6½c. per lb., the inside figure obtaining for material in bags.

White Lead—Demand was quiet and, with the metal lower, talk of a lower selling schedule was not considered out of place. In fact it was known that leading interests actually considered a change in prices. Standard dry white lead was quotably unchanged at 10½c. per lb. Pig lead settled at 8¼c. so far as the leading producer was concerned, but outside lots actually sold as low as 7.90c., New York.

Zinc Oxide—There was a lower market for zinc, but this did not result in a change in oxides. American process, lead free, held at 7¼c. per lb. French process, red seal, 9¼c. per lb.

Imports at the Port of New York

April 11 to April 17

ACIDS—Cresylic—43 dr., Liverpool, W. E. Jordan & Bro.; 7 dr., Liverpool, Order; 60 dr., Liverpool, W. E. Jordan & Bro. **Acetic**—8 cs., Glasgow, Order. **Citric**—100 bbl., Messina, Order; 825 csk., Palermo, Order. **Oxalic**—66 csk., Christiania, Roessler & Haaslach Chemical Co. **Stearic**—20 cs., Rotterdam, M. W. Parsons-Plymouth Organic Laboratories. **Tartaric**—500 csk., Palermo, Order.

ALCOHOL—100 bbl. denatured, Arecibo, C. Esteve.

ALUM—135 bbl., Hull, American-Hawthorn S. S. Co.

ANTIMONY REGULUS—500 cs., Hankow, Bank of N. Y. & Trust Co.; 150 cs., Hankow, National Bank of Commerce; 500 cs., Hankow, Asia Banking Corp.; 250 cs., Hankow, Bank of N. Y. & Trust Co.; 200 cs., Hankow, C. Hardy, Inc.; 750 cs., Hankow, Bank of N. Y. & Trust Co.; 1,300 cs., Shanghai, International Banking Corp.; 500 cs., Shanghai, Columbia Bank; 150 cs., Hankow, Irving Bank-Col. Trust Co.; 350 cs., Hankow, National Bank of Commerce; 1,000 cs., Shanghai, International Banking Corp.

ANTIMONY—17 csk. star, Newcastle-on-Tyne, E. Hill's Sons & Co.; 250 cs., Hankow, I. R. Boody & Co.

ARSENIC—488 bbl., Tampico, American Smelting & Refining Co.; 100 csk., Kobe, J. D. Lewis; 500 cs., Kobe, G. Wills & Sons; 300 cs., Kobe, G. Wills & Sons; 50 csk., Rotterdam, C. B. Richard & Co.; 24 cs., Hankow, Order; 200 cs., Shanghai, International Banking Corp.; 118 bbl., Tampico, American Smelting & Refining Co.; 184 csk. and 171 bbl., Antwerp, Irving Bank-Col. Trust Co.; 50 bbl., Antwerp, Roessler & Haaslach Chemical Co.

ASBESTOS—500 bbl., Cape Town, Irving Bank-Col. Trust Co.; 440 bg., Cape Town, Asbestos, Ltd.; 2,523 bg., Beira, W. D. Crompton & Co.; 527 bg., Cape Town, National Bank of South Africa.

BARIUM CARBONATE—175 bg., Newcastle-on-Tyne, R. W. Greeff & Co.; 100 tons, Newcastle-on-Tyne, Bankers Trust Co.; 50 tons, Newcastle-on-Tyne, W. Schall & Co.

BARIUM NITRATE—60 csk., Rotterdam, Phila. National Bank.

CALCIUM CARBONATE—400 bg., Bremen, Lehn & Fink.

CALCIUM CITRATE—362 csk., Messina, C. Pfizer & Co.; 124 csk., Messina, Order.

CALCIUM NITRATE—36 csk., Porsgrund, Order.

CASEIN—250 bg., Buenos Aires, Order; 700 bg., Buenos Aires, Brown Bros. & Co.; 2,501 bg., Buenos Aires, Kalbfleisch Corp.

CAMPOR—250 cs. synthetic, Rotterdam, G. W. Sheldon & Co.

CHALK—1,106 tons, Dunkirk, Taintor Trading Corp.; 300 bg., Antwerp, L. H. Butcher & Co.

CHEMICALS—12 csk., Bremen, Hummel & Robinson; 10 bbl., Bremen, Order; 50 cs., Hamburg, Odol Chemical Corp.; 40 cs., Hamburg, Order; 200 csk., Rotterdam, Chemical National Bank; 40 csk., Rotterdam, Hans Hinrichs Chemical Co.; 280 bg., Glasgow, Coal & Iron National Bank; 443 bg., Glasgow, Brown Bros. & Co.; 12 csk., Rotterdam, Order; 28 cs., Havre, E. Fougere & Co.; 4 cs., Havre, Order; 283 pkg., Hamburg, Jungmann & Co.

CHINA CLAY—300 bg., Bristol, Bankers Trust Co.; 667 bg. and 50 csk., Bristol, C. T. Wilson & Co.; 200 bg. and 250 csk., Bristol, H. J. Baker & Bros.; 30 csk., Bristol, L. H. Butcher & Co.; 898 tons, Bristol, Order.

COAL-TAR DISTILLATE—217 dr., Liverpool, Order; 60 dr., Glasgow, Order; 38 dr., Liverpool, Monsanto Chemical Works; 219 dr., Liverpool, Order.

COLORS—23 bbl., Bremen, G. Siegle Corp. of Am.; 19 cs., Hamburg, M. Grumbacher; 5 csk. alizarine, Liverpool, Order; 14 csk. dry, Hamburg, G. Siegle Corp.; 12 csk. aniline, Hamburg, H. A. Metz & Co.; 14 csk. do., Hamburg, Kuttroff, Pickhardt & Co.; 10 csk. do., Hamburg, Ciba Co.; 34 pkg. aniline, Rotterdam, Kuttroff, Pickhardt & Co.; 8 csk. do., Rotterdam, Earle & Co.; 5 csk. do., Rotterdam, Bank of the Manhattan Co.; 4 bbl. do., Rotterdam, American Exchange National Bank; 2 bbl. do., Rotterdam, Bernard Barnard & Co.;

46 pkg. aniline, Rotterdam, Grasselli Chemical Co.; 7 csk. do., Rotterdam, Garfield Aniline Works; 31 pkg. do., Rotterdam, H. A. Metz & Co.; 5 csk. do., Rotterdam, Carbolic Color & Chem. Co.; 15 cs. aniline, Havre, Order.

COPPER SULPHATE—200 csk., Liverpool, Order.

CREAM TARTAR—100 csk., Bordeaux, Order.

CRESOL—15 dr. solid, Liverpool, Monsanto Chemical Works.

DIVI-DIVI—296 bg., Pampatar, Standard Commodities Co.; 502 bg., Pampatar, Eggers & Heinlein; 200 bg., Cumana, Scholtz & Co.

EPSOM SALT—500 bg., Bremen, E. Suter & Co.

FERROSILICON—520,650 kilos (in bulk) and 28 csk., Stavanger, Electro Metallurgical Co.

GAMBIER—850 cs., Asahan, Order; 413 cs., Singapore, Order; 265 cs., Singapore, Order.

GLYCERINE—40 bbl., St. Nazaire, Marx & Rawolle, Inc.; 10 csk., Bordeaux, Marx & Rawolle, Inc.; 40 csk., Bordeaux, Order; 10 dr., Rotterdam, Cordillera Comm. Co.; 20 dr., Antwerp, Order.

GRAPHITE—500 bg., Genoa, Order; 1,500 bg., Fusan, Mitsui & Co.; 819 bg., Marseilles, H. W. Peabody & Co.

GUMS—1,350 bg. arabic, Port Sudan, Thurston & Braidich; 250 bg. do., Port Sudan, T. M. Duche & Sons; 250 bg. do., Port Sudan, Anglo-Egypt Bank; 270 bg. do., Port Sudan, Order; 200 cs. damar,

Padang, Schulz & Ruckgaber; 420 bg. damar and 30 pkg. copal, Singapore, Kidder, Peabody & Co.; 100 cs. damar, Singapore, L. C. Gillespie & Sons; 258 cs. do., Singapore, Baring Bros. & Co.; 579 pkg. damar and 100 cs. copal, Singapore, Order; 200 cs. damar, Batavia, Order; 100 cs. damar, Batavia, Guaranty Trust Co.; 100 cs. do., Batavia, Irving Bank-Col. Trust Co.; 400 cs. damar, Batavia, Order; 368 bskt. copal, Macassar, Order; 210 bg. damar and 50 cs. copal, Singapore, Baring Bros. & Co.; 140 cs. damar, Singapore, Guaranty Trust Co.; 600 bg. arabic, Port Sudan, Br. Bank of South America; 320 bg. copal and 128 bg. damar, Singapore, Brown Bros. & Co.; 192 bg. copal, Singapore, Guaranty Trust Co.; 100 cs. copal, Singapore, L. C. Gillespie & Sons; 655 cs. kauri, Auckland, Order; 996 bg. copal, Antwerp, Order.

IRON CHLORIDE—29 bbl., Rotterdam, C. Hardy, Inc.

IRON OXIDE—120 bbl., Malaga, E. M. & F. Waldo; 14 bbl., Malaga, Bohner, Gehrig & Co.; 95 bbl., Malaga, Reichard-Coulston, Inc.; 703 bbl., Malaga, C. K. Williams & Co.; 102 bbl., Malaga, Order; 47 csk., Liverpool, J. A. McNulty; 25 csk., Liverpool, R. J. Waddell & Co.; 20 csk., Liverpool, Reichard-Coulston, Inc.; 12 csk., Liverpool, Order; 320 bg., Bristol, C. Z. Collins & Co.; 18 csk., Bristol, Order; 8 csk., Liverpool, Order; 288 bbl., Malaga, C. J. Osborn Co.; 228 bbl., Malaga, Am. Exchange National Bank; 50 bbl., Malaga, M. P. Tribuno; 74 bbl., Malaga, L. H. Butcher & Co.; 60 bbl., Malaga, S. L. Libby Corp.

IRON PERCHLORIDE—11 csk. and 20 keg, Newcastle-on-Tyne, Roessler & Haaslach Chemical Co.

LAMPBLACK—150 csk., Antwerp, F. Van Gelsten.

LITHOPONE—40 csk., Rotterdam, L. H. Butcher & Co.; 60 csk., Rotterdam, Reichard-Coulston, Inc.; 800 csk., Antwerp, B. Moore & Co.; 101 csk., Antwerp, E. M. & F. Waldo; 60 csk., Antwerp, A. Klipstein & Co.

LOGWOOD EXTRACT—58 csk., Kingston, J. Campbell & Co.; 105 bbl., Cape Haitian, Logwood Mfg. Co.

MAGNESITE—12,000 bg., Madras, Order.

MAGNESIUM CITRATE—100 cs., Genoa, Order.

MAGNESIUM POWDER—4 cs., Bremen, Electron Metals Corp.

MAGNESIUM CARBONATE—160 bg., Newcastle-on-Tyne, Order; 6 cs., Newcastle-on-Tyne, E. Hill's Sons & Co.

MANGROVE BARK EXTRACT—1,000 bg., Singapore, Order; 2,000 bg., Beira, Order; 1,500 bg., Singapore, Order; 500 bg., Singapore, Order.

MANGANESE OXIDE—4 csk., Manchester, Order.

MANGANESE CHLORIDE—92 bbl., Bremen, Order.

MINERAL WHITE—100 bg., Hull, Whittaker, Clarke & Daniels.

MYROBALAMS—1,685 bg., Bombay, Order; 450 pkt., Calcutta, Order.

NAPHTHALENE—675 bg., Antwerp, Order.

OCHE—720 csk., Marseilles, Reichard-Coulston, Inc.; 499 bbl., Marseilles, American Exchange National Bank; 100 bbl., Marseilles, J. Lee Smith & Co.

OILS—Coconut—700 tons (in bulk), Manila, Proctor & Gamble Co.; 693 tons, Cebu, Philippine Refining Co.; 875 tons, Manila, Co. de Tabacoo de Filipinas; 658 tons, Manila, International Banking Corp.; 696 tons, Manila, Order. **Cod**—100 bbl., Hull, Bowring & Co.; 460 bbl., Hull, Order. **China Wood**—280 bbl., Hankow, Standard Bank of South Africa; 27 dr., Shanghai, Order; 151 csk., Hankow, Order; 56 dr., Hong Kong, Order. **Olive Foots** (Sulphur Oil)—100 bbl., Leghorn, Bank of Manhattan Co.; 100 bbl., Naples, Order; 200 bbl., Catania, E. M. Sergeant & Co.; 200 csk., Palermo, Order; 100 bbl., Leghorn, Order; 90 bbl., Genoa, Order; 600 bbl., Messina,

Opportunities in the Foreign Trade

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.

ANHYDROUS AMMONIA. Horta, Azores. Purchase.—9829.

BAKELITE. Milan, Italy. Exclusive agency.—9864.

BLACK, CARBON GAS. Liège, Belgium. Agency.—9853.

CAUSTIC SODA, chromate of potassium, and sodium chromate. Vienna, Austria. Purchase and agency.—9857.

DYES, ANILINE, and chemicals used in dyeing processes. Damascus, Syria. Purchase and agency.—9855.

ENAMELS, varnishes of first qualities for automobiles. Stockholm, Sweden. Purchase.—9858.

GLYCERIN, crude. Brussels, Belgium. Purchase.—9849.

LEAD AND COPPER ACETATE. Liège, Belgium. Agency.—9852.

PAINTS AND VARNISHES. Horta, Azores. Purchase.—9829.

PAINTS AND VARNISHES. Galata, Turkey. Agency.—9856.

POTASSIUM AND SODIUM BICHROMATES. Liège, Belgium. Agency.—9853.

ROSIN, PITCH AND STEARINE. Vienna, Austria. Purchase and agency.—9857.

TAR from gas works. Stockholm, Sweden. Agency.—9859.

WAXES. Milan, Italy. Exclusive agency.—9864.

BONE GREASE, for leather industry. Milan, Italy. Agency.—9837.

OILS, FATS AND OILSEEDS, especially Philippine copra. Hamburg, Germany. Agency.—9845.

OILS AND TALLOW for soap making. Brussels, Belgium. Purchase.—9849.

(Continued on page 654)

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

General Chemicals

Acetone, drums, wks.	lb.	\$0.16 - \$0.17
Acetic anhydride, 85%, dr.	lb.	.38 - .40
Acid, acetic, 28%, bbl.	100 lb.	3.37 - 3.62
Acetic, 56%, bbl.	100 lb.	6.35 - 6.60
Acetic, 80%, bbl.	100 lb.	8.90 - 9.15
Glacial, 99%, bbl.	100 lb.	11.90 - 12.15
Boric, bbl.	lb.	.10 - .12
Citric, kegs.	lb.	.45 - .47
Formic, 85%, bbl.	lb.	.13 - .13 1/2
Gallie, tech.	lb.	.45 - .50
Hydrofluoric, 52%, carboys	lb.	.11 - .12
Lactic, 44%, tech., light, bbl.	lb.	.12 - .13
22% tech., light, bbl.	lb.	.06 - .06 1/2
Muriatic, 18% tanks	100 lb.	.80 - .85
Muriatic, 20%, tanks	100 lb.	.95 - 1.00
Nitric, 36%, carboys	lb.	.04 - .04 1/2
Nitric, 42%, carboys	lb.	.04 - .05 1/2
Oleum, 20%, tanks	ton	16.00 - 17.00
Oxalic, crystals, bbl.	lb.	.10 - .11
Phosphoric, 50%, carboys	lb.	.07 - .08 1/2
Pyrogallie, resublimed.	ton	1.55 - 1.60
Sulphuric, 60%, tanks	ton	9.00 - 10.00
Sulphuric, 60%, drums	ton	13.00 - 14.00
Sulphuric, 66%, tanks	ton	14.00 - 15.00
Sulphuric, 66%, drums	ton	19.00 - 20.00
Tannic, U.S.P., bbl.	lb.	.65 - .70
Tannic, tech., bbl.	lb.	.45 - .50
Tartaric, imp., powd., bbl.	lb.	.27 - .28
Tartaric, domestic, bbl.	lb.	.30 - .32
Tungstic, per lb.	lb.	1.20 - 1.25
Alcohol, butyl, drums, f.o.b. works	lb.	.25 - .30
Alcohol ethyl (Cologne spirit), bbl.	gal.	4.85 - .00
Ethyl, 190 p.f. U.S.P., bbl.	gal.	4.81 - .00
Alcohol, methyl (see Methanol)		
Alcohol, denatured, 190 proof	gal.	.51 - .00
No. 1, special bbl.	gal.	.45 - .00
No. 1, 190 proof, special, dr.	gal.	.52 - .00
No. 1, 188 proof, bbl.	gal.	.48 - .00
No. 1, 188 proof, dr.	gal.	.50 - .00
No. 3, 188 proof, bbl.	gal.	.44 - .00
No. 3, 188 proof, dr.	gal.	.03 - .04
Alum, ammonia, lump, bbl.	lb.	.03 - .04
Potash, lump, bbl.	lb.	.05 - .06
Chrome, lump, potash, bbl.	lb.	.05 - .06
Aluminum sulphate, com. bags	100 lb.	1.40 - 1.50
Iron free bags	lb.	2.40 - 2.50
Aqua ammonia, 26%, drums	lb.	.06 - .06 1/2
Ammonia, anhydrous, cyl.	lb.	.28 - .30
Ammonium carbonate, powd. tech., casks	lb.	.12 - .13
Ammonium nitrate, tech., casks	lb.	.09 - .10
Amyl acetate tech., drums	gal.	3.25 - 3.75
Antimony oxide, white, bbl.	lb.	.09 - .10
Arsenic, white, powd., bbl.	lb.	.10 - .11
Arsenic, red, powd., kegs	lb.	.14 - .15
Barium carbonate, bbl.	ton	67.00 - 68.00
Barium chloride, bbl.	ton	85.00 - 90.00
Barium dioxide, 88%, drums	lb.	.17 - .18
Barium nitrate, casks	lb.	.08 - .08 1/2
Blanc fixe, dry, bbl.	lb.	.03 - .04
Bleaching powder, f.o.b. wks. drums	100 lb.	1.90 - .00
Spot N. Y. drums	100 lb.	2.25 - 2.35
Borax, bbl.	lb.	.05 - .05 1/2
Bromine, cases	lb.	.28 - .30
Calcium acetate, bags	100 lb.	3.50 - 3.55
Calcium arsenate, dr.	lb.	.11 - .11 1/2
Calcium carbide, drums	lb.	.05 - .05 1/2
Calcium chloride, fused, dr. wks.	ton	21.00 - .00
Gran. drums works	ton	27.00 - .00
Calcium phosphate, mono, bbl.	lb.	.06 - .07
Camphor, Jap. cases	lb.	.75 - .76
Carbon bisulphide, drums	lb.	.06 - .06 1/2
Carbon tetrachloride, drums	lb.	.07 - .08
Chalk, precip.—domestic, light, bbl.	lb.	.04 - .04 1/2
Domestic, heavy, bbl.	lb.	.03 - .04
Imported, light, bbl.	lb.	.04 - .05
Chlorine, liquid, tanks, wks.	lb.	.04 - .00
Contract, tanks, wks.	lb.	.04 - .00
Cylinders, 100 lb. wks.	lb.	.03 - .07 1/2
Chloroform, tech., drums	lb.	.30 - .32
Cobalt, oxide, bbl.	lb.	2.10 - 2.25
Copperas, bulk, f.o.b. wks.	ton	16.00 - 18.00
Copper carbonate, bbl.	lb.	.16 - .17
Copper cyanide, drums	lb.	.45 - .46
Copper sulphate, dom., bbl., 100 lb.	lb.	4.90 - 5.00
Imp bbl.	100 lb.	4.50 - 4.60
Cream of tartar bbl.	lb.	.21 - .22
Epsom salt, dom., tech., bbl.	100 lb.	1.75 - 2.00
Epsom salt, imp., tech., bags	100 lb.	1.10 - 1.20
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.25 - 2.50
Ether, U.S.P., dr.	lb.	.14 - .15
Ethyl acetate, 85%, drums	gal.	1.00 - .00

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

Ethyl acetate, 99%, dr.	gal.	\$1.15 - .00
Formaldehyde, 40%, bbl.	lb.	.10 - .11
Fullers earth—f.o.b. mines	ton	7.50 - 18.00
Furfural, works, bbl.	lb.	.25 - .00
Fusel oil, ref., drums	gal.	3.50 - .00
Fusel oil, crude, drums	gal.	2.50 - 2.75
Glaucous salt, wks., bags	100 lb.	1.20 - 1.40
Glaucous salt, imp., bags	100 lb.	1.00 - 1.05
Glycerine, c.p., drums extra	lb.	.17 - .00
Glycerine, dynamite, drums	lb.	.16 - .00
Glycerine, crude 80%, loose	lb.	.11 - .11 1/2
Hexamethylene, drums	lb.	.68 - .75
Lead:		
White, basic carbonate, dry, casks	lb.	.10 - .00
White, basic sulphate, casks	lb.	.09 - .00
White, in oil, kegs	lb.	.12 - .00
Red, dry, casks	lb.	.12 - .00
Red, in oil, kegs	lb.	.13 - .00
Lead acetate, white crys., bbl.	lb.	.15 - .00
Brown, broken, casks	lb.	.14 - .00
Lead arsenate, powd., bbl.	lb.	.18 - .20
Lime-Hydrated, bg, wks.	ton	10.50 - 12.50
Bbl., wks.	ton	18.00 - 19.00
Lime, lump, bbl.	280 lb.	3.63 - 3.65
Litharge, comm., casks	lb.	.11 - .00
Lithopone, bags	lb.	.06 - .06 1/2
Magnesium carb., tech., bags	lb.	.08 - .08 1/2
Methanol, 95%, bbl.	gal.	.93 - .00
Methanol, 97%, bbl.	gal.	.95 - .00
Methanol, pure, tanks	gal.	.90 - .00
drums	gal.	1.00 - .00
bbl.	gal.	1.05 - .00
Methyl acetate, tks.	gal.	.90 - .91
Nickel salt, double, bbl.	lb.	.09 - .10 1/2
Nickel salts, single, bbl.	lb.	.10 - .11
Orange mineral, cak.	lb.	.14 - .15 1/2
Phosgene	lb.	.60 - .75
Phosphorus, red, cases	lb.	.70 - .75
Phosphorus, yellow, cases	lb.	.35 - .40
Potassium bichromate, casks	lb.	.09 - .09 1/2
Potassium bromide, gran., bbl.	lb.	.19 - .20
Potassium carbonate, 80-85%, calcined, casks	lb.	.06 - .06 1/2
Potassium chlorate, powd.	lb.	.07 - .08 1/2
Potassium cyanide, drums	lb.	.47 - .52
Potassium, first sort, cask	lb.	.07 - .08
Potassium hydroxide (caustic potash) drums	lb.	.06 - .06 1/2
Potassium iodide, cases	lb.	3.65 - 3.75
Potassium nitrate, bbl.	lb.	.07 - .09
Potassium permanganate, drums	lb.	.14 - .14 1/2
Potassium prussiate, red, casks	lb.	.40 - .43
Potassium prussiate, yellow, casks	lb.	.19 - .19 1/2
Salammoniac, white, gran., casks, imported	lb.	.06 - .00
Salammoniac, white, gran., bbl., domestic	lb.	.07 - .07 1/2
Gray, gran., casks	lb.	.08 - .09
Salsoda, bbl.	100 lb.	1.20 - 1.40
Salt cake (bulk) works	ton	23.00 - .00
Soda ash, light, 58% flat, bulk, contract	100 lb.	1.25 - .00
bags, contract	100 lb.	1.38 - .00
Soda ash, dense, bulk, contract, basis 58%	100 lb.	1.35 - .00
bags, contract	100 lb.	1.45 - .00
Soda, caustic, 76%, solid, drums contract	100 lb.	3.10 - .00
Soda, caustic, ground and flake, contracts, dr.	100 lb.	3.50 - 3.85
Soda, caustic, solid, 76%, f. a. s. N. Y.	100 lb.	3.00 - .00
Sodium acetate, works, bbl.	lb.	.05 - .05 1/2
Sodium bicarbonate, bulk, 100 lb.	lb.	1.75 - .00
350-lb. bbl.	100 lb.	2.00 - .00
Sodium bichromate, casks	lb.	.07 - .07 1/2
Sodium bisulphate (niter ake) ton	ton	6.00 - 7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04 - .04 1/2
Sodium chlorate, kegs	lb.	.06 - .07
Sodium chloride, long ton	ton	12.00 - 13.00
Sodium cyanide, cases	lb.	.19 - .22

Sodium fluoride, bbl.	lb.	\$0.09 - \$0.10 1/2
Sodium hyposulphite, bbl.	lb.	.02 - .02 1/2
Sodium nitrite, casks	lb.	.98 - .08 1/2
Sodium peroxide, powd., cases	lb.	.28 - .30
Sodium phosphate, dibasic, bbl.	lb.	.03 - .03 1/2
Sodium prussiate, yel. bbl.	lb.	.10 - .12
Sodium salicylic, drums	lb.	.38 - .40
Sodium silicate (40% drums)	100 lb.	.75 - 1.15
Sodium silicate (60% drums)	100 lb.	1.75 - 2.00
Sodium sulphide, fused, 60-62% drums	lb.	.03 - .03 1/2
Sodium sulphite, crys., bbl.	lb.	.03 - .03 1/2
Strontium nitrate, powd., bbl.	lb.	.10 - .10 1/2
Sulphur chloride, yel drums	lb.	.04 - .05
Sulphur, crude	ton	18.00 - 20.00
At mine, bulk	ton	16.00 - 18.00
Sulphur, flour, bag	100 lb.	2.25 - 2.35
Sulphur, roll, bag	100 lb.	2.00 - 2.10
Sulphur dioxide, liquid, cyl.	lb.	.08 - .08
Tin bichloride, bbl.	lb.	.14 - .00
Tin oxide, bbl.	lb.	.55 - .00
Tin crystals, bbl.	lb.	.35 - .00
Zinc carbonate, bags	lb.	.14 - .14 1/2
Zinc chloride, gran, bbl.	lb.	.05 - .05 1/2
Zinc cyanide, drums	lb.	.36 - .37
Zinc dust, bbl.	lb.	.08 - .08 1/2
Zinc oxide, lead free, bag	lb.	.07 - .00
5% lead sulphate, bags	lb.	.07 - .00
10 to 35 % lead sulphate, bags	lb.	.07 - .00
French, red seal, bags	lb.	.09 - .00
French, green seal, bags	lb.	.10 - .00
French, white seal, bbl.	lb.	.12 - .00
Zinc sulphate, bbl.	100 lb.	3.00 - 3.25

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	\$0.60 - \$0.65
Alpha-naphthol, ref., bbl.	lb.	.70 - .75
Alpha-naphthylamine, bbl.	lb.	.35 - .36
Aniline oil, drums	lb.	.16 - .16 1/2
Aniline salts, bbl.	lb.	.22 - .23
Anthracene, 80%, drums	lb.	.75 - .80
Anthraquinone, 25%, paste, drums	lb.	.75 - .80
Benzaldehyde U.S.P., carboys f.f.e. drums	lb.	1.50 - .00
tech, drums	lb.	1.60 - .72
Benzene, pure, water-white, tanks, works	gal.	.25 - .00
Benzene, 90%, tanks, works	gal.	.23 - .00
Benzidine base, bbl.	lb.	.80 - .82
Benzidine sulphate, bbl.	lb.	.70 - .72
Benzoic acid, U.S.P., kegs	lb.	.82 - .85
Benzoate of soda, U.S.P., bbl.	lb.	.65 - .70
Benzyl chloride, 95-97%, ref., carboys	lb.	.35 - .00
Benzyl chloride, tech., drums	lb.	.25 - .00
Beta-naphthol, tech., bbl.	lb.	.24 - .25
Beta-naphthylamine, tech.	lb.	.65 - .70
Cresol, U.S.P., drums	lb.	.23 - .28
Ortho-cresol, drums	lb.	.28 - .32
Cresylic acid, 97%, works drums	gal.	.68 - .72
95-97%, drums, works	gal.	.65 - .68
Dichlorobenzene, drums	lb.	.07 - .08
Diethylaniline, drums	lb.	.53 - .55
Dimethylaniline, drums	lb.	.36 - .38
Dinitrobenzene, bbl.	lb.	.17 - .19
Dinitrochlorobenzene, bbl.	lb.	.21 - .22
Dinitronaphthalen, bbl.	lb.	.30 - .32
Dinitrophenol, bbl.	lb.	.35 - .40
Dinitrotoluen, bbl.	lb.	.18 - .20
Dip oil, 25%, drums	gal.	.26 - .28
Diphenylamine, bbl.	lb.	.50 - .52
H-acid, bbl.	lb.	.72 - .75
Meta-phenylenediamine, bbl.	lb.	.95 - 1.00
Michlers ketone, bbl.	lb.	3.00 - 3.50
Monochlorobenzene, drums	lb.	.08 - .10
Monochloroaniline, drums	lb.	.95 - 1.10
Naphthalene, flake, bbl.	lb.	.05 - .06
Naphthalene, balls, bbl.	lb.	.06 - .07
Naphthionate of soda, bbl.	lb.	.60 - .65
Naphthionic acid, crude, bbl.	lb.	.60 - .62
Nitrobenzene, drums	lb.	.09 - .09 1/2
Nitro-naphthalene, bbl.	lb.	.25 - .30
Nitro-toluene, drums	lb.	.13 - .14
N-W acid, bbl.	lb.	1.05 - 1.10
Ortho-amidophenol, kegs	lb.	2.40 - 2.50
Ortho-dichlorobenzene, drums	lb.	.12 - .13
Ortho-nitrophenol, bbl.	lb.	1.25 - 1.30
Ortho-nitrotoluene, drums	lb.	.11 - .12
Ortho-toluidine, bbl.	lb.	.12 - .13
Para-aminophenol, base, kegs	lb.	1.25 - 1.35
Para-aminophenol, HCl, kegs	lb.	1.45 - 1.60
Para-dichlorobenzene, bbl.	lb.	.17 - .20
Paranitraniline, bbl.	lb.	.68 - .70
Para-nitrotoluene, bbl.	lb.	.58 - .60
Para-phenylenediamine, bbl.	lb.	1.40 - 1.50
Para-toluidine, bbl.	lb.	.76 - .83
Phthalic anhydride, bbl.	lb.	.30 - .34
Phenol, U.S.P., dr.	lb.	.26 - .29
Picric acid, bbl.	lb.	.20 - .22
Pitch, tanks, works	ton	25.00 - 30.00
Pyridine, imp., drums	gal.	4.00 - 4.25
Resorcinol, tech., kegs	lb.	1.30 - 1.40

Resorcinol, pure, kegs.....	lb.	\$2.05 - \$2.10
H-salt, bbl.....	lb.	.35 - .60
Salicylic acid, tech., bbl.....	lb.	.32 - .33
Salicylic acid, U.S.P., bbl.....	lb.	.35 - .
Solvent naphtha, water-white, tanks.....	gal.	.25 - .
Crude, tanks.....	gal.	.22 - .
Sulphanilic acid, crude, bbl.....	lb.	.16 - .18
Tolidine, bbl.....	lb.	1.00 - 1.05
Tolidine, mixed, kegs.....	lb.	.30 - .35
Toluene, tank cars, works.....	gal.	.30 - .
Toluene, drums, works.....	gal.	.30 - .
Xylidine, drums.....	lb.	.40 - .
Xylene, pure, tanks.....	gal.	.40 - .
Xylene, com., tanks.....	gal.	.28 - .

Naval Stores

Rosin B-D, bbl.....	280 lb.	\$5.80 - .
Rosin E-I, bbl.....	280 lb.	5.80 - .
Rosin K-N, bbl.....	280 lb.	5.90 - \$6.10
Rosin W.G.-W.W., bbl.....	280 lb.	7.00 - 7.40
Wood rosin, bbl.....	280 lb.	5.80 - 5.90
Turpentine, spirits of, bbl.....	gal.	.98 - .
Wood, steam dist., bbl.....	gal.	.90 - .
Wood, dest. dist., bbl.....	gal.	.68 - .
Pine tar pitch, bbl.....	200 lb.	5.50 - .
Tar, kiln burned, bbl.....	500 lb.	11.00 - .
Retort tar, bbl.....	500 lb.	11.00 - .
Rosin oil, first run, bbl.....	gal.	.41 - .
Rosin oil, second run, bbl.....	gal.	.45 - .
Rosin oil, third run, bbl.....	gal.	.47 - .
Pine oil, steam dist., bbl.....	gal.	.65 - .
Pine tar oil, ref.....	gal.	.50 - .

Animal Oils and Fats

Degras, bbl.....	lb.	\$0.03 - \$0.05
Grease, yellow, loose.....	lb.	.06 - .06
Lard oil, Extra No. 1, bbl.....	gal.	.85 - .
Lard compound, bbl.....	lb.	.12 - .12
Neatfoot oil 20 deg. bbl.....	gal.	1.28 - .
No. 1, bbl.....	gal.	.88 - .92
Oleo Stearine.....	lb.	.10 - .
Oleo oil, No. 1, bbl.....	lb.	.12 - .
Red oil, distilled, d.p. bbl.....	lb.	.08 - .09
Saponified, bbl.....	lb.	.08 - .09
Tallow, extra, loose.....	gal.	.07 - .
Tallow oil, acidless, bbl.....	gal.	.83 - .

Vegetable Oils

Castor oil, No. 3, bbl.....	lb.	\$0.15 - .
Castor oil, No. 1, bbl.....	lb.	.16 - .
China wood oil, bbl.....	lb.	.14 - .14
Cocoon oil, Ceylon, bbl.....	lb.	.09 - .
Ceylon, tanks, N.Y.....	lb.	.08 - .
Cocoon oil, Cochon, bbl.....	lb.	.10 - .10
Corn oil, crude, bbl.....	lb.	.10 - .11
Crude, tanks, (f.o.b. mill).....	lb.	.09 - .
Cottonseed oil, crude (f.o.b. mill), tanks.....	lb.	.08 - .
Summer yellow, bbl.....	lb.	.10 - .11
Winter yellow, bbl.....	lb.	.11 - .
Linseed oil, raw, ear lots, bbl.....	gal.	.90 - .
Raw, tank cars (dom.).....	gal.	.84 - .
Boiled, ears, bbl.....	gal.	.92 - .
Olive oil, denatured, bbl.....	gal.	1.25 - 1.30
Sulphur, (foots) bbl.....	lb.	.09 - .10
Palm, Lagos, cases.....	lb.	.07 - .
Niger, cases.....	lb.	.06 - .
Palm kernel, bbl.....	lb.	.08 - .09
Peanut oil, crude, tanks (mill).....	lb.	.11 - .
Peanut oil, refined, bbl.....	lb.	.14 - .14
Perilla, bbl.....	lb.	.92 - .94
Flaxseed oil, refined, bbl.....	gal.	.10 - .11
Sesame, bbl.....	lb.	.11 - .
Soya bean (Manchurian), bbl.....	lb.	.10 - .
Tank, f.o.b. Pacific coast.....	lb.	.10 - .
Tank, (f.o.b. N.Y.).....	lb.	.10 - .

Fish Oils

Cod, Newfoundland, bbl.....	gal.	\$0.62 - \$0.65
Menhaden, light pressed, bbl.....	gal.	.60 - .
White bleached, bbl.....	gal.	.62 - .
Blown, bbl.....	gal.	.66 - .
Crude, tanks (f.o.b. factory).....	gal.	. - .
Whale No. 1 crude, tanks, coast.....	lb.	.75 - .76
Winter, natural, bbl.....	gal.	.75 - .76
Winter, bleached, bbl.....	gal.	.78 - .79

Oil Cake and Meal

Cocoon cake, bags.....	ton	\$30.00 - .
Cottonseed meal, f.o.b. mills.....	ton	38.00 - .
Linseed cake, bags.....	ton	34.00 - 35.00
Linseed meal, bags.....	ton	39.00 - 40.00

Dye & Tanning Materials

Albumen, blood, bbl.....	lb.	\$0.50 - \$0.55
Albumen, egg, tech, kegs.....	lb.	.95 - .97
Cochineal, bags.....	lb.	.32 - .34
Cuteh, Borneo, bales.....	lb.	.04 - .04
Cuteh, Rangoon, bales.....	lb.	.13 - .14
Dextrine, corn, bags.....	100 lb.	3.74 - 3.94
Dextrine, gum, bags.....	100 lb.	4.09 - 4.19
Divi-divi, bags.....	ton	38.00 - 39.00
Fustie, sticks.....	ton	30.00 - 35.00
Fustie, chips, bags.....	lb.	.04 - .05
Gambier com., bags.....	lb.	.10 - .11
Logwood, sticks.....	ton	25.00 - 26.00
Logwood, chips, bags.....	lb.	.02 - .03
Sumac, leaves, Sicily, bags.....	ton	150.00 - 160.00
Sumac, ground, bags.....	ton	50.00 - 55.00
Sumac, domestic, bags.....	ton	3.12 - 3.22
Starch, corn, bags.....	100 lb.	.05 - .06
Tapioea flour, bags.....	lb.	.05 - .06

Extracts

Arehil, conc., bbl.....	lb.	\$0.16 - \$0.20
Chestnut, 25% tannin, tanks.....	lb.	.01 - .02
Divi-divi, 25% tannin, bbl.....	lb.	.04 - .05
Fustie, crystals, bbl.....	lb.	.20 - .22
Fustie, liquid, 42%, bbl.....	lb.	.08 - .09
Gambier, liq., 25% tannin, bbl.....	lb.	.09 - .10
Hematin crys., bbl.....	lb.	.14 - .18
Hemlock, 25% tannin, bbl.....	lb.	.03 - .04
Hypernic, solid, drums.....	lb.	.24 - .26
Hypernic, liquid, 51%, bbl.....	lb.	.09 - .10
Logwood, crys., bbl.....	lb.	.14 - .15
Logwood, liq., 51%, bbl.....	lb.	.08 - .09
Osage Orange, 51%, liquid, bbl.....	lb.	.07 - .08
Osage Orange, powder, bg.....	lb.	.14 - .15
Quebracho, solid, 65% tannin, bbl.....	lb.	.05 - .05
Sumac, dom., 51%, bbl.....	lb.	.06 - .07

Dry Colors

Blacks-Carbons, bags, f.o.b. spot, cases.....	lb.	\$0.07 - \$0.09
Lampblack, bbl.....	lb.	.11 - .15
Mineral, bulk.....	ton	35.00 - 45.00
Blues-Bronze, bbl.....	lb.	.40 - .43
Prussian, bbl.....	lb.	.40 - .43
Ultramarine, bbl.....	lb.	.08 - .35
Browns, Sienna, Ital., bbl.....	lb.	.06 - .14
Sienna, Domestic, bbl.....	lb.	.03 - .04
Umber, Turkey, bbl.....	lb.	.04 - .04
Greens-Chrome, C.P. Light, bbl.....	lb.	.28 - .30
Chrome, commercial, bbl.....	lb.	.12 - .12
Paris, bulk.....	lb.	.26 - .28
Reds, Carmine No. 40, tins.....	lb.	4.50 - 4.70
Iron oxide red, cases.....	lb.	.10 - .16
Para toner, kegs.....	lb.	1.00 - 1.10
Vermilion, English, bbl.....	lb.	1.25 - .
Yellow, Chrome, C.P. bbls.....	lb.	.16 - .17
Ocher, French, cases.....	lb.	.02 - .03

Waxes

Bayberry, bbl.....	lb.	\$0.22 - \$0.23
Beeswax, crude, Afr. bg.....	lb.	.25 - .26
Beeswax, refined, light, bags.....	lb.	.32 - .34
Beeswax, pure white, cases.....	lb.	.40 - .41
Candelilla, bags.....	lb.	.23 - .23
Carnauba, No. 1, bags.....	lb.	.38 - .40
No. 2, North Country, bags.....	lb.	.28 - .29
No. 3, North Country, bags.....	lb.	.19 - .20
Japan, cases.....	lb.	.24 - .25
Montan, crude, bags.....	lb.	.05 - .06
Paraffine, crude, match, 105-110 m.p., bbl.....	lb.	.05 - .
Crude, scale 124-126 m.p. bags.....	lb.	.05 - .
Ref., 118-120 m.p., bags.....	lb.	.05 - .
Ref., 123-125 m.p., bags.....	lb.	.05 - .
Ref., 128-130 m.p., bags.....	lb.	.05 - .
Ref., 133-135 m.p., bags.....	lb.	.06 - .
Ref., 135-137 m.p., bags.....	lb.	.06 - .06
Stearic acid, acid pressed, bags.....	lb.	.11 - .11
Double pressed, bags.....	lb.	.11 - .11
Triple pressed, bags.....	lb.	.13 - .13

Fertilizers

Acid phosphate, 16%, bulk, works.....	ton	\$7.50 - \$7.75
Ammonium sulphate, bulk f.o.b. works.....	100 lb.	2.80 - 2.85
Blood, dried, bulk.....	unit	4.10 - 4.15
Bone, raw, 3 and 50, ground.....	ton	26.00 - 28.00
Fish scrap, dom., dried, wks.....	unit	. - .
Nitrate of soda, bags.....	100 lb.	2.75 - .
Tankage, high grade, f.o.b. Chicago.....	unit	2.25 - .
Phosphate rock, f.o.b. mines.....	ton	3.30 - 4.20
Florida pebble, 68-72%.....	ton	7.00 - 7.25
Tennessee, 75%.....	ton	34.55 - .
Potassium muriate, 80%, bags.....	ton	45.85 - .
Potassium sulphate, bags basis 90%.....	ton	27.00 - .
Double manure salt.....	ton	7.22 - .
Kainit.....	ton	. - .

Crude Rubber

Para-Upriver fine.....	lb.	\$0.19 - .
Upriver coarse.....	lb.	.16 - .
Upriver cauchoball.....	lb.	.18 - .
Plantation-First latex crepe.....	lb.	.22 - .
Ribbed smoked sheets.....	lb.	.22 - .
Amber crepe No. 1.....	lb.	.22 - .

Gums

Copal, Congo, amber, bags.....	lb.	\$0.10 - \$0.15
East Indian, bold, bags.....	lb.	.20 - .21
Manila, pale, bags.....	lb.	.19 - .20
Pontinak, No. 1 bags.....	lb.	.19 - .20
Damar, Batavia, cases.....	lb.	.24 - .25
Singapore, No. 1, cases.....	lb.	.31 - .32
Singapore, No. 2, cases.....	lb.	.21 - .22
Kauri, No. 1, cases.....	lb.	.62 - .64
Ordinary chips, cases.....	lb.	.20 - .21
Manjak, Barbados, bags.....	lb.	.08 - .11

Shellac

Shellac, orange fine, bags.....	lb.	\$0.59 - \$0.60
Orange superfine, bags.....	lb.	.61 - .62
A.C. garnet, bags.....	lb.	.56 - .57
Bleached, bonedry.....	lb.	.67 - .
Bleached, fresh.....	lb.	.56 - .
T.N., bags.....	lb.	.57 - .

Miscellaneous Materials

Asbestos, Quebec No. 1, f.o.b., Quebec.....	sh. ton	\$300.00 - \$400.00
Asbestos, shingle, f.o.b. Quebec.....	sh. ton	50.00 - 70.00
Asbestos, cement, f.o.b. Quebec.....	sh. ton	20.00 - 25.00
Barytes, grd., white, f.o.b. mills, bbl.....	net ton	16.00 - 17.00
Barytes, grd., off-color, f.o.b. Balt.....	net ton	13.00 - 14.00
Barytes, floated, f.o.b. St. Louis, bbl.....	net ton	23.00 - 24.00
Bar ytes, crude f.o.b. mines, bulk.....	net ton	8.00 - 8.50
Casein, bbl., tech.....	lb.	.11 - .12
China clay (kaolin) crude, No. 1, f.o.b. Ga.....	net ton	7.00 - 8.00
Washed, f.o.b. Ga.....	net ton	8.50 - 9.00
Powd., f.o.b. Ga.....	net ton	13.00 - 20.00
Crude f.o.b. Va.....	net ton	6.00 - 8.00
Ground, f.o.b. Va.....	net ton	13.00 - 19.00
Imp., lump, bulk.....	net ton	15.00 - 20.00
Imp., powd.....	net ton	45.00 - 50.00
Feldspar, No. 1 f.o.b. N.C. long ton.....	6.50 - 7.00	
No. 2 f.o.b. N.C. long ton.....	4.50 - 5.00	
No. 1 soap long ton.....	7.00 - .	
No. 1 Canadian, f.o.b. mill, powd.....	long ton	20.00 - .
Graphite, Ceylon, lump, first quality, bbl.....	lb.	.05 - .06
Ceylon, chip, bbl.....	lb.	.04 - .05
High grade amorphous crude.....	ton	15.00 - 35.00
Gum arabic, amber, sorts, bags.....	lb.	.11 - .11
Gum tragacanth, sorts, bags.....	lb.	.48 - .53
No. 1, bags.....	lb.	1.35 - 1.40
Kieselguhr, f.o.b. Cal.....	ton	40.00 - 42.00
F.o.b. N.Y.....	ton	50.00 - 55.00
Magnesite, calcined, f.o.b. Cal. ton.....	35.00 - 45.00	
Pumice stone, imp., cases.....	lb.	.03 - .35
Dom., lump, bbl.....	lb.	.05 - .05
Dom., ground, bbl.....	lb.	.05 - .06
Silica, glass sand, f.o.b. Ind. ton.....	2.00 - 2.50	
Silica, sand blast, f.o.b. Ind. ton.....	2.25 - 3.50	
Silica, amorphous, 200-mesh, f.o.b. Ill.....	ton	20.00 - .
Silica, glass sand, f.o.b. Ill. ton.....	1.75 - 3.00	
Soapstone, coarse, f.o.b. Vt., bags.....	ton	7.50 - 8.00
Talc, 200 mesh, f.o.b. Vt., bags, extra.....	ton	10.00 - .
Talc, 200 mesh, f.o.b. Ga., bags.....	ton	8.00 - 12.00
Talc, 325 mesh, f.o.b. New York, grade A bags.....	ton	14.75 - .

Mineral Oils

Crude, at Wells

Pennsylvania.....	bbl.	\$4.00 - \$4.50
Corning.....	bbl.	2.15 - .
Cabell.....	bbl.	2.20 - .
Somermet.....	bbl.	2.30 - 2.50
Illinois.....	bbl.	2.07 - .
Indiana.....	bbl.	2.08 - .
Kansas and Okla. under 28 deg. bbl.....	bbl.	1.00 - .
California, 35 deg. and up.....	bbl.	1.40 - .

Gasoline, Etc.

Motor gasoline, steel bbls.....	gal.	\$0.20 - .
Naphtha, V. M. & P. dead, steel bbls.....	gal.	.19 - .
Kerosene, ref. tank wagon.....	gal.	.15 - .
Bulk, W.W. delivered, N.Y.....	gal.	.08 - .
Lubricating oils:		
Cylinder, Penn., filtered.....	gal.	.32 - .38
Bloomless, 30@31 grav.....	gal.	.20 - .
Paraffin, pale.....	gal.	.18 - .18
Spindle, 200, pale.....	gal.	.22 - .
Petrolatum, amber, bbls.....	lb.	.04 - .04
Paraffine wax (see waxes).....		

Refractories

Bauxite brick, 56% Al ₂ O ₃ , f.o.b. Pittsburgh.....	1,000	\$140-\$145
Chrome brick, f.o.b. Eastern shipping points.....	ton	45-47
Chrome cement, 40-50% Cr ₂ O ₃ , 40-45% Cr ₂ O ₃ , sacks, f.o.b. Eastern shipping points.....	ton	23-27
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.....	1,000	42-45
2nd. quality, 9-in. shapes, f.o.b. wks.....	1,000	35-38
Magnesite brick, 9-in. straight (f.o.b. wks.).....	ton	65-68
9-in. arches, wedges and keys.....	ton	80-85
Scrap and splits.....	ton	.85
Silica brick, 9-in. sizes, f.o.b. Chicago district.....	1,000	50-53
Silica brick, 9-in. sizes, f.o.b. Birmingham district.....	1,000	50-53
F.o.b. Mt. Union, Pa.....	1,000	42-45
Silicon carbide refract. brick, 9-in.....	1,000	1180.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls.....	ton	\$200.00 - .
N.Y.....		

Ferrochromium, per lb. of		
Cr, 1-2% C..... lb.	\$0.30	.....
4-6% C..... lb.	.114	.....
Ferromanganese, 78-82%		
Mn, Atlantic seabd.		
duty paid..... gr. ton	107.50	.....
Spiegeleisen, 19-21% Mn..... gr. ton	38.00	40.00
Ferromolybdenum, 50-60%		
Mo, per lb. Mo..... lb.	2.00	2.50
Ferrosilicon, 10-12%..... gr. ton	41.50	46.50
50%..... gr. ton	75.00	80.00
Ferrotungsten, 70-80%		
per lb. of W..... lb.	.91	.93
Ferro-uranium, 35-50%, of		
U, per lb. of U..... lb.	4.50	.....
Ferrovandium, 30-40%		
per lb. of V..... lb.	3.50	4.00

Ores and Semi-finished Products

Bauxite, dom. crushed,		
dried, f.o.b. shipping		
points..... ton	\$5.50	\$8.75
Chrome ore Calif. concen-		
trates, 50% min. Cr ₂ O ₃ ton	22.00	23.00
C.i.f. Atlantic seaboard..... ton	19.00	24.00
Coke, f.fry., f.o.b. ovens..... ton	4.75	5.25
Coke, furnace, f.o.b. ovens..... ton	3.75	4.00
Fluorspar, gravel, f.o.b.		
mines, Illinois..... ton	23.50	.....
Ilmenite, 52% TiO ₂ Va..... lb.	.014	.....
Manganese ore, 50% Mn,		
c.i.f. Atlantic seaboard..... unit	.44	.46
Manganese ore, chemical		
(MnO ₂)..... ton	75.00	80.00
Molybdenite, 85% MoS ₂ ,		
per lb. MoS ₂ , N. Y..... lb.	.80	.....
Monazite, per unit of ThO ₂		
c.i.f. Atl. seaboard..... lb.	.06	.08
Pyrites, Span., fines, c.i.f.		
Atl. seaboard..... unit	.114	.12
Pyrites, Span., furnace size,		
c.i.f. Atl. seaboard..... unit	.114	.12
Pyrites, dom. fines, f.o.b.		
mines, Ga..... unit	.12	.....
Rutile, 95% TiO ₂ lb.	.12	.15
Tungsten, scheelite, 60%		
WO ₃ and over..... unit	9.50	.....
Tungsten, wolframite, 60%		
WO ₃ unit	9.00	9.25
Uranium ore (carnotite) per		
lb. of U ₃ O ₈ lb.	3.50	3.75
Uranium oxide, 96% per lb.		
U ₃ O ₈ lb.	12.25	2.50
Vanadium pent oxide, 99%..... lb.	2.00	14.00
Vanadium ore, per lb. V ₂ O ₅ lb.	1.00	1.25
Zircon, 99%..... lb.	.06	.07

Non-Ferrous Metals

Copper, electrolytic..... lb.	\$0.134	.....
Aluminum, 98 to 99%..... lb.	.27	\$.28
Antimony, wholesale, Chinese		
and Japanese..... lb.	.10	.....
Nickel, 99%..... lb.	.27	.30
Monel metal, shot and blocks		
Tin, 5-ton lots, Straits..... lb.	.32	.....
Lead, New York, spot..... lb.	.071	.081
Lead, E. St. Louis, spot..... lb.	.071	.071
Zinc, spot, New York..... lb.	.0640	.....
Zinc, spot, E. St. Louis..... lb.	.0605	.....
Silver (commercial)..... oz.	.64	.....
Cadmium..... lb.	.60	.....
Bismuth (500 lb. lots)..... lb.	2.35	.....
Cobalt..... lb.	2.50-3.00	.....
Magnesium, ingots, 99%..... lb.	.90-.95	.....
Platinum, refined..... oz.	115.00	.....
Iridium..... oz.	275.00-300.00	.....
Palladium..... oz.	85.00	.....
Mercury..... 75 lb.	74.00-76.00	.....
Tungsten powder..... lb.	.95-1.00	.....

Finished Metal Products

	Warehouse Price	Cents per lb.
Copper sheets, hot rolled.....	19.75	
Copper bottoms.....	29.75	
Copper rods.....	20.25	
High brass wire.....	18.75	
High brass rods.....	16.00	
Low brass wire.....	20.50	
Low brass rods.....	21.00	
Brass tubing.....	24.50	
Brass tubing.....	25.75	
Seamless copper tubing.....	23.75	
Seamless high brass tubing.....	22.50	

OLD METALS—The following are the dealers purchasing prices in cents per pound

Copper, heavy and crucible.....	11.50 @ 12.00
Copper, heavy and wire.....	11.00 @ 11.25
Copper, light and bottoms.....	9.00 @ 9.25
Lead, heavy.....	6.25 @ 6.50
Lead, tea.....	4.25 @ 4.50
Brass, heavy.....	6.00 @ 6.25
Brass, light.....	5.00 @ 5.25
No. 1 yellow brass turnings.....	7.00 @ 7.25
Zinc scrap.....	4.00 @ 4.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by 1/2 in. and larger, and plates 1/2 in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes.....	\$3.54	\$3.54
Soft steel bars.....	3.54	3.54
Soft steel bar shapes.....	3.54	3.54
Soft steel bands.....	4.39	4.39
Plates, 1/2 to 1 in. thick.....	3.64	3.64

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Alabama

CRICHTON—The Mobile Paper Mills, Inc., recently formed with a capital of \$200,000, will begin immediately the erection of its proposed local plant on site previously occupied by the Gulf Mills, lately purchased. The initial mill will be 1-story, 60x350 ft., and will be equipped for the manufacture of paperboard products. It is expected to develop an output of 30 tons per day. Equipment contracts will be placed at once. J. M. Walsh is president; and R. J. Milling secretary and treasurer.

California

COLTON—Bellmar Brothers, Los Angeles, are perfecting plans for the erection of a new local plant for the manufacture of cottonseed oil products. A site has been acquired and plans for the initial units will be prepared at an early date. The estimated cost is placed at \$200,000, including equipment.

PETALUMA—Jacob Kreh, Petaluma, has preliminary plans under way for the construction of a new plant on local site for the manufacture of crayons, pastes and kindred specialties. The initial works is estimated to cost about \$25,000.

FRESNO—The Pacific Gas & Electric Co., 445 Sutter St., San Francisco, has plans nearing completion for the construction of a new artificial gas plant at Thorne and Button Sts., estimated to cost \$170,000. It is expected to commence work at an early date.

EMERYVILLE—In connection with its expansion plans, previously announced, the Paraffine Companies, Inc., 40 1st St., San Francisco, will install considerable additional machinery at its local mill, to cost in excess of \$300,000. The plant is used for the manufacture of paper products and affiliated specialties, and will develop large increase in output.

Colorado

MONTE VISTA—The American Beet Sugar Co., 32 Nassau St., New York, N. Y., is reported to have tentative plans under consideration for the erection of a new local sugar mill, with estimated cost placed at close to \$500,000, including power house and auxiliary departments.

Connecticut

EAST HARTFORD—The Robinson Clay Products Co., 949 Broadway, New York, manufacturer of sewer pipe, tile, etc., with plants at Akron, O., Clearfield, Pa., and other locations, has acquired a local site, 550x550 ft., for a new factory branch and distributing works. Plans will soon be drawn.

Florida

CLERMONT—The Florida Diatomite Co., recently organized in West Virginia, with E. O. Young, Huntington, W. Va., president, has a tract of local mineral lands and plans for the early installation of machinery for development and operation. A commercial refining works will be established. C. Lindley Wood is secretary and chemical engineer; H. C. Brown is general manager.

PALATKA—The Palatka Moss Products Co. has begun the erection of a new plant on North 8th St., comprising a 2-story building for the production and curing of moss for commercial service. Two adjoining structures will be built, consisting of a power house and storage building. The plant is estimated to cost about \$30,000.

Illinois

CHICAGO—The C. A. Mosso Laboratories, 2253 Warren Ave., manufacturer of oil of salt and other chemical specialties, has acquired a 2-story building at 215 South Leavitt St., heretofore held by the White Motor Products Co., and will remove its plant to this location. It is proposed to install additional equipment for increased output. E. B. Penney heads the company.

CHICAGO—Fire, April 7, damaged a portion of the 4-story plant of the Plunkett

Chemical Co., 3500 South Morgan St., with loss reported at \$15,000, including equipment. It is planned to rebuild.

CHICAGO—The National Glass Co., 907 Blue Island Ave., has acquired a 3-story factory at Warren and Paulina Sts., on site 125x180 ft., heretofore held by the Midland Metal Co., for a consideration stated at \$56,000. The new owner plans to occupy the property at an early date for extensions. Improvements will be made to accommodate the new line of production.

Kansas

CANEY—The Connelly Glass Co., manufacturer of window glass, has tentative plans under advisement for the rebuilding of the portion of its local plant, destroyed by fire, April 6, with loss estimated at close to \$200,000, including equipment. The reconstruction is estimated to cost approximately a like amount. New machinery will be installed. G. W. Connelly is president.

INDEPENDENCE—Fire, April 8, destroyed a portion of the plant of the Mid-Western Paint Co., with loss estimated at about \$13,000. It is planned to rebuild.

Maryland

ST. HELENA (Baltimore)—The Chemical & Pigment Co. has awarded a general contract to the Austin Co., Euclid Ave., Cleveland, O., for the erection of five new additions to its plant for the manufacture of chemicals, dry colors, etc. The structures will be each 1-story, 80x100 ft., 56x120 ft., 50x72 ft., and two 40x60 ft. Work will begin at once.

BALTIMORE—The Bethlehem Steel Co., Bethlehem, Pa., is said to be perfecting plans for proposed extensions and improvements in its local mill in the Sparrows Point section, comprising for the most part expansion in the rail department, estimated to cost approximately \$500,000, with equipment.

FRANKLINVILLE—The Oak Tire & Rubber Co., 125 West Mt. Royal Ave., Baltimore, has acquired a local building, 2-story, 50x230 ft., and will establish a new plant for the manufacture of automobile tires and other rubber products. The structure will be remodeled and improved and equipment installed at an early date.

Massachusetts

MILFORD—The William J. Collins Foundry Co. has construction in progress on a new 1-story foundry, 55x60 ft., with extension, 15x30 ft., for the production of iron and other metal castings. A general building contract has been let to Dillon Brothers, Milford. It is proposed to have the structure ready for equipment at an early date. William J. Collins is head.

Michigan

MENOMINEE—The Menominee & Martine Paper Co. has plans under way for the erection of a new 1-story addition to cost about \$200,000, including equipment. Property heretofore owned by the city will be purchased for a site. Bids will be asked in the near future.

Minnesota

DULUTH—The Dominion Tar & Chemical Co., Fremont St., is having plans completed for the erection of a new plant at Fremont and South 60th Sts., to be 1-story, estimated to cost approximately \$35,000, including equipment. Robert Holmes is one of the heads of the company in charge.

Missouri

SPRINGFIELD—The Tulsa Oxy-Hydro Co., Tulsa, Okla., manufacturer of industrial oxygen, carbide products, etc., is planning for the establishment of a new branch plant here, for the manufacture of its regular line of specialties. It is estimated to cost about \$35,000, including equipment. Willard Foster is president.

Nevada

RENO—The Valley Concrete Pipe & Products Co., Yuba City, Calif., has leased local

property at 4th and Alameda Sts., and plans the establishment of a new branch plant for the manufacture of concrete pipe and other cement products. It is purposed to install equipment at an early date.

New Jersey

PERTH AMBOY—The New Jersey Wood Finishing Co., Amboy Ave. and Cutters Lane, manufacturer of varnishes, etc., has awarded a general contract to A. K. Jensen, Perth Amboy, for the erection of two additions to its plant, comprising a 1- and 2-story building, to be used as a melting works and for varnish manufacture, respectively. The expansion will cost about \$34,000.

TRENTON—The Thomas Maddock's Sons Co., Perry and Ewing Sts., manufacturer of sanitary ware, has asked bids on a general contract for the erection of the initial plant units for its proposed pottery on site recently acquired at Hutchinson's Mills, Hamilton Township. The new plant is estimated to cost in excess of \$350,000, with equipment. It is purposed to remove the present works to the new location as the new buildings are completed. W. E. S. Dyer, Land Title Bldg., Philadelphia, Pa., is architect and engineer.

New York

LONG ISLAND CITY—Roon & Lewin, 1328 Broadway, New York, N. Y., manufacturers of chemical products, have acquired property on Skillman Ave., near Van Pelt St., Long Island City, totaling about 11,350 sq. ft., and plan for the erection of a new plant on the site. It is expected to break ground within 30 days.

NEW YORK—The Hunt Brick & Asphalt Co., 601 East Tremont Ave., is completing plans and will soon begin the erection of a new plant at Viele Ave. and Tiffany St., for the manufacture of cement brick and kindred products. It will be 1-story, 100x200 ft., estimated to cost about \$100,000, including equipment. F. Wolfgang, 535 East Tremont Ave., is architect. C. Breidenbach heads the company.

ROCHESTER—The Lawless Paper Co., North Water St., manufacturer of manila, tissue and other papers, has tentative plans under advisement for the rebuilding of the portion of its plant destroyed by fire, April 8, with loss estimated at \$75,000, including equipment.

BUFFALO—The Cataract-Sharp Mfg. Co., 232 Winchester St., manufacturer of cut glass products, has filed plans for the erection of a 1-story addition, 40x42 ft.

SPARROWBUSH—Officials of Clarence T. Birkett, Inc., 452 Lexington Ave., New York, are said to be perfecting plans for the organization of a subsidiary company to operate its tanning plant at Sparrowbush, which has been idle for close to 2 years past. A number of improvements will be made, including equipment installation, to modernize all departments. Frank J. Norris will be superintendent.

Ohio

ZANESVILLE—The Mosaic Tile Co. is planning to begin work early in May on its proposed new plant at Brighton, to be 4-story, estimated to cost about \$250,000, including equipment. Bids will be asked at once on a general contract. It is purposed to have the pottery ready for the machinery installation during the summer.

MASSILLON—The Ohio Glass Products Co. is arranging for enlargements in its plant, to include the installation of two lehrs, each 10 ft. wide and 70 ft. long, and other equipment. The lehrs will be furnished by the Amsler-Morton Co., Pittsburgh, Pa.

Pennsylvania

PHILADELPHIA—The John T. Lewis & Brother Co., Thompson St., manufacturer of paints, varnishes, etc., has awarded a general contract to the Turner Construction Co., 1713 Sansom St., for extensions and improvements in its plant to cost about \$17,000. Work will begin at once.

PHILADELPHIA—Fire, April 7, damaged a portion of the oil refinery of the Atlantic Refining Co., Point Breeze section, with loss reported at \$40,000. It is planned to replace the loss at once.

CONSHOHOCKEN—The Alan Wood Iron & Steel Co., manufacturer of open-hearth steel billets, plates, sheets, etc., is planning for the erection of additional finishing mills at its plant, as well as improvements and equipment installation in present finishing mills for increased output. A portion of a \$3,500,000 bond issue, now being sold, will be used for the expansion. Richard G. Wood is president.

Texas

HOUSTON—The Eagle Rubber & Chemical Co., 1009 Eagle Ave., is said to be arranging plans for the rebuilding of the portion of its plant recently destroyed by fire with loss estimated at \$70,000, including equipment.

Vermont

RUTLAND—The Rutland Fire Clay Co. has tentative plans under advisement for the erection of a new 3-story refractory plant, 50x120 ft., estimated to cost in excess of \$80,000, including equipment.

Virginia

HOPEWELL—The Dixie Decorating Co., recently organized with a capital of \$40,000, is perfecting arrangements for extensions and improvements in its local plant, devoted primarily to the production of decorated chinaware. A new decorating kiln and other equipment will be installed. Contract has been let for a portion of the equipment and other orders will be placed at an early date. F. F. Nickell is president; and C. T. Wilson, secretary.

West Virginia

HUNTINGTON—The International Nickel Co., 67 Wall St., New York, N. Y., has awarded a general contract to the McClintic-Marshall Co., Pittsburgh, Pa., for the erection of a new addition to its plant, 90x100 ft., to be used primarily for expansion in the calciner department. Additional furnaces and other equipment will be installed. Work will be placed in progress at once. W. L. Wotherspoon is engineer.

DUNBAR—The Merit Cut Glass Co., is arranging for early operations at its new local plant on Myers Ave., now nearing completion, to specialize in the production of cut glass products. The initial installation will consist of six electrically operated machines, and additional units will be installed in the near future.

Imports at New York

(Continued from page 650)

Order; 150 bbl. Bari, Ital. Discount & Trust Co.; 100 bbl. Bari, Fourth Street National Bank, Philadelphia; 100 bbl. Bari, Brown Bros. & Co.; 100 bbl. Bari, National Shawmut Bank; 550 bbl. Bari, National City Bank; 300 bbl. Bari, W. R. Grace & Co.; 100 bbl. Bari, Philadelphia Natl. Bank; 400 bbl. Bari, Bank of the Manhattan Co.; 300 bbl. Patna, Order; 500 bbl. Naples, Central Bank, Comm. Italiano; 350 bbl. Naples, Order. **Palm Kernel**—141 bbl. Liverpool, African & Easter Trading Co. **Rapeseed**—650 bbl. Hull, Vacuum Oil Co.; 325 bbl. Hull, J. C. Francesconi & Co.; 520 bbl. Hull, Order. **Seal**—40 bbl. Christiania, Order. **Sesame**—151 bbl. Manchester, Order.

OIL SEEDS—**Copra**—659 bg., Trinidad, Order. **Castor**—2,716 bg., Bombay, Order. **Linseed**—8,728 bg., Buenos Aires, L. Dreyfus & Co.; 55,134 bg. and 2,251,264 kilos (in bulk), Rosario, Order; 17,075 bg., Buenos Aires, Order. **Sesame**—1,400 bg., Hankow, Bordon Wolf Cowen Co.; 350 bg., Hankow, Irving Bank-Col. Trust Co.; 300 bg., Shanghai, Wah Chang Trading Corp.

PITCH—80 bg. stearine, Hull, Order. **PLUMBAGO**—100 bbl., Colombo, Irving Bank-Col. Trust Co.; 1,144 bg., Colombo, Brown Bros. & Co.; 150 bbl., Colombo, N. Y. Trust Co.; 32 bbl., Colombo, Order; 66 bbl., Colombo, Order.

POTASSIUM SALTS—50 bbl. sulphate and 30 bg. muriate, Bremen, Potash Importing Corp. of America; 10 csk. salts, Hamburg, Order; 200 csk. nitrate, Rotterdam, Superfos Co.; 18 csk. carbonate, Bremen, P. H. Petry & Co.; 40 kg bicarbonate, Bristol, Order; 4,295 bg. muriate, Antwerp, Societe Comm. des Potasses d'Alsace.

PUMICE—200 bg. powdered, Canneto Lipari, C. B. Chrystal & Co.; 5,632 bg., Canneto Lipari, R. J. Waddell & Co.; 60 bg., Canneto Lipari, Order.

QUEBRACHO—29,110 bg., Buenos Aires, Tannin Corp.; 1,271 bg., Buenos Aires, Order; 5,473 bg., Buenos Aires, Tannin Corp.

QUICKSILVER—100 flask, Genoa, Order. **SAL AMMONIAC**—150 cs., Bristol, C. De P. Field Co.

SHELLAC—100 bg., Southampton, Order; 200 bg., Hull, National Shawmut Bank; 75 bg., Hamburg, Ralli Bros.; 95 bg. garnet, Hamburg, Kasebier - Chatfield

Shellac Co.; 17 cs., Penang, D. L. Silverman; 100 cs., Bangkok, Order; 100 bg., Calcutta, J. W. Green & Co.; 414 pkg., Calcutta, Order; 176 cs., Marseilles, Order; 40 bg. garnet, Hamburg, F. E. Gerlach; 25 cs., Hamburg, Rogers, Pyatt Shellac Co.

SILVER SULPHIDE—6 cs., South American ports, Bank of Central & South America.

SODIUM SALTS—255 csk. nitrite, Christiania, Order; 100 bg. salt cake, Rotterdam, M. E. McGovern; 3,735 bg. nitrate, Porsgrund, Order; 277 csk. hyposulphite, Marseilles, Order; 112 cs. cyanide, Havre, International Banking Corp.; 600 bg. phosphate, Antwerp, Hollinghurst & Co.; 68 csk. prussiate, Liverpool, Order; 142 cs. cyanide, Liverpool, Order; 240 csk. hyposulphate, Hamburg, C. Hardy, Inc.

STARCH—750 bg. potato, Rotterdam, Rutgers, Bleecker & Co.; 1,900 bg., Rotterdam, Stein, Hall & Co.; 250 bg., Rotterdam, Chicago Starch Co.; 200 bg., Copenhagen, Stein, Hall & Co.

SUMAC—190 bl. leaf and 350 bg. ground, Palermo, Order; 490 bg., Palermo, Order.

TALC—500 bg., Genoa, C. Mathieu; 200 bg., Genoa, L. A. Salomon & Bros.; 200 bg. Genoa, Order; 1,000 bg., Bordeaux, Hammill, Gillespie & Co.; 800 bg., Bordeaux, L. A. Salomon Bros.; 300 bg., Bordeaux, Isolantile, Inc.

TARTAR—450 pkg., Naples, Tartar Chemical Works; 31 csk. and 99 bg. Leghorn, Tartar Chemical Works; 210 bg., Naples, C. Pfizer & Co.; 606 bg., Buenos Aires, Anglo South American Trust Co.; 745 bg., Marseilles, Royal Baking Powder Co.; 530 bbl., Marseilles, C. Pfizer & Co.; 265 bg., Marseilles, Royal Baking Powder Co.; 137 bg., Tarragona, Order.

TURMERIC—240 bg., Aleppo, National City Bank; 400 bg., Aleppo, Order; 1,000 bg., Cochín, Order.

TIN OXIDE—2 bbl., Santos, Pitt & Scott; 2 bbl., Rio de Janeiro, American Express Co.

VALONEA—3,690 bg., Constantinople, Order.

WATTLE BARK—1,522 bg., Durban, Hammond & Carpenter; 3,156 bg., Durban, Tannin Corp.; 2,004 bg., Morondava, Order.

WAXES—1,600 bg. paraffine, Balikpapan, Asiatic Petroleum Co.; 24 bg. beeswax, Alexandria, Order; 1,000 bg. montan, Hamburg, Irving Bank-Col. Trust Co.; 31 bg. mineral, Hamburg, L. S. Tainter; 31 pkg. beeswax, Hamburg, Elbert & Co.; 266 pkg. beeswax, Rangoon, Order; 161 bg. ozokerite, Trieste, Order; 72 bbl. beeswax, Rotterdam, Order; 97 bg. beeswax, Constantinople, Order; 16 bg. ceresin, Hamburg, Order.

WOOL GREASE—70 csk., Bremen, Pfaltz & Bauer; 32 bbl., Manchester, Swan & Finch Co.; 90 bbl., Antwerp, Order.

ZINC OXIDE—250 bbl., Marseilles, Irving Bank-Col. Trust Co.; 50 bbl., Antwerp, Philipp Bros.

New Companies

SMITH COLOR & CHEMICAL CO., 5144 East Monroe St., Springfield, Ill.; chemicals and chemical byproducts, colors, etc.; \$200,000. Incorporators: Arthur E. Prince, George E. Smith and George W. Solomon.

BOWERS POTTERY CO., Mannington, W. Va.; chinaware and other pottery products; \$675,000. Incorporators: George W. and Frank W. Bowers, both of Mannington.

THOMAS GRIFFIN LEATHER CORP., Boston, Mass.; leather products; \$50,000. Thomas E. Griffin, 53 Chester Rd., Belmont, Mass., is president and treasurer.

ATLANTIC SMELTING CORP., Newark, N. J.; smelting and refining of metals; \$50,000. Incorporators: Isaac and Morris Birenbaum, and Helleck Sack. Representative: William Harris, 790 Broad St., Newark.

CALIFORNIA KELP CO., Los Angeles, Calif.; commercial kelp production; \$1,000,000. Incorporators: Thomas Humphreys, Dr. Carl Schultz and Andrew Brown. Representative: Charles F. Reiche, 808 Bank of Italy Bldg., Los Angeles.

GENEVA CHEMICAL CORP., New York, N. Y.; chemicals and chemical byproducts; \$10,000 and 1,000 shares common stock, no par value. Incorporators: W. Muller, P. L. Leach and S. J. Oberwager. Representative: Benjamin Krauss, 233 Broadway, New York.

PURITAN MFG. CO., Waterbury, Conn.; chemicals and chemical byproducts; \$50,000. Incorporators: E. C. Meuten, E. A. O'Rourke and Francis T. Reeves, 65 Bank St., Waterbury. The last noted is representative.